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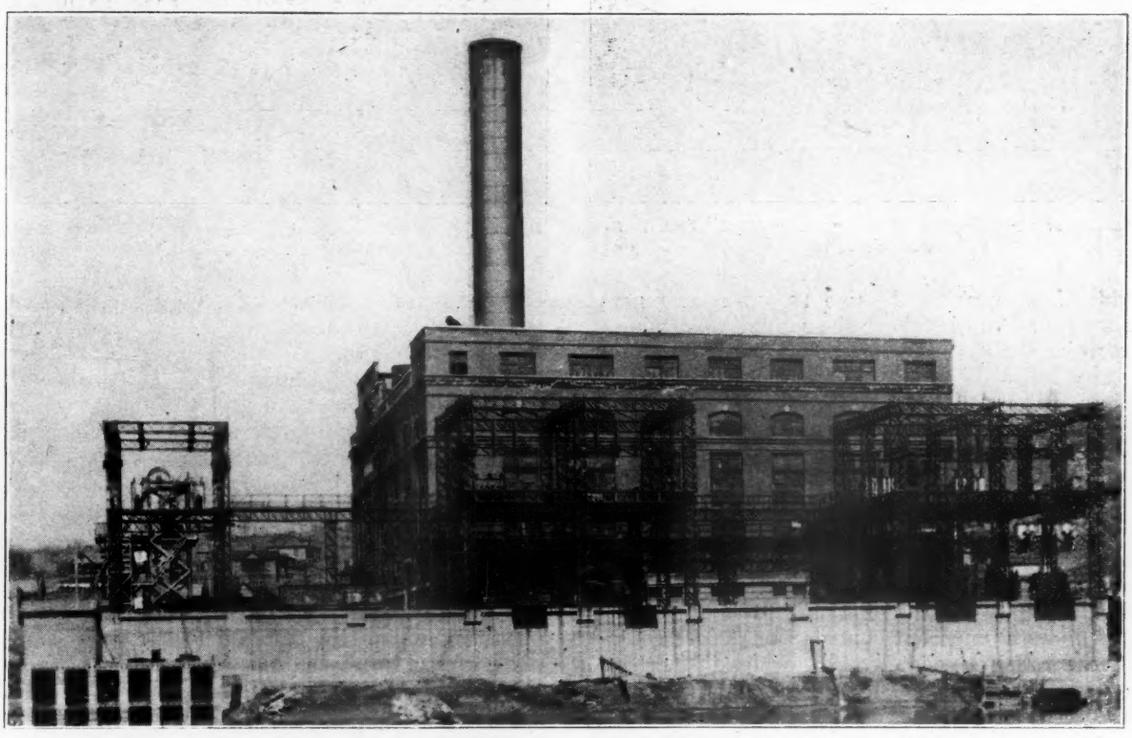


General View of Generating Station of Monongahela Valley Traction Co. Near Fairmont, W. Va.

Switching Equipment of Modern Generating Stations

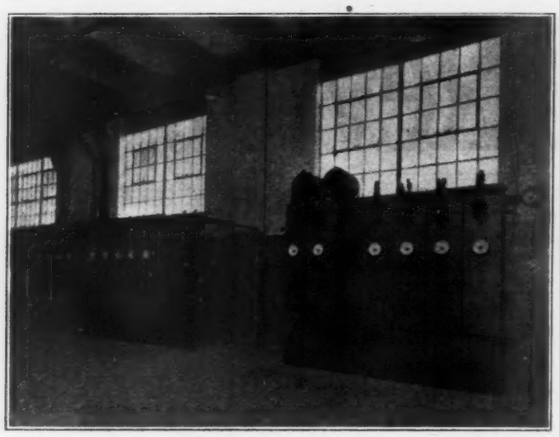
Instrument Transformers, Switches, Main and Secondary Fuses Located in Five-Story Switch House — Operating Room Overlooks Generator Floor and Contains Boards for Station Control

By F. G. HICKLING

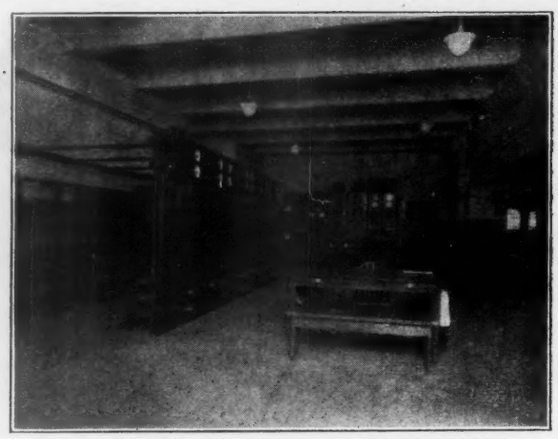
Westinghouse Electric & Manufacturing Co.

During the period of power-station development when the large reciprocating engine was in its prime the problem of laying out switching equipment was comparatively simple. The longitudinal dimension of the station was usually adequate to allow all of the switchgear to be placed on one floor. With the advent of the steam turbine and the consequent centralization of large blocks of power the problem of insuring continuous efficient service within commercial limits became involved. For these reasons heavy switching apparatus is now designed for remote electrical control operation, and structures are designed for flexibility and safety of operation with accessibility to apparatus and minimum operating costs.

An instance of this modern station practice is found in the Rivesville station of the Monongahela Valley Traction Co. located near Fairmont, W. Va., in the center of a coal field. Here the switchgear is designed for ease of control and flexibility of operation. The apparatus is located on five levels adjacent to the main generating room. As shown in the accompanying cross-sectional diagram of the station, the main circuits run upward from floor to floor, starting with the generator cable at the bottom and ending with the feeder lines at the top. The 11,000-volt



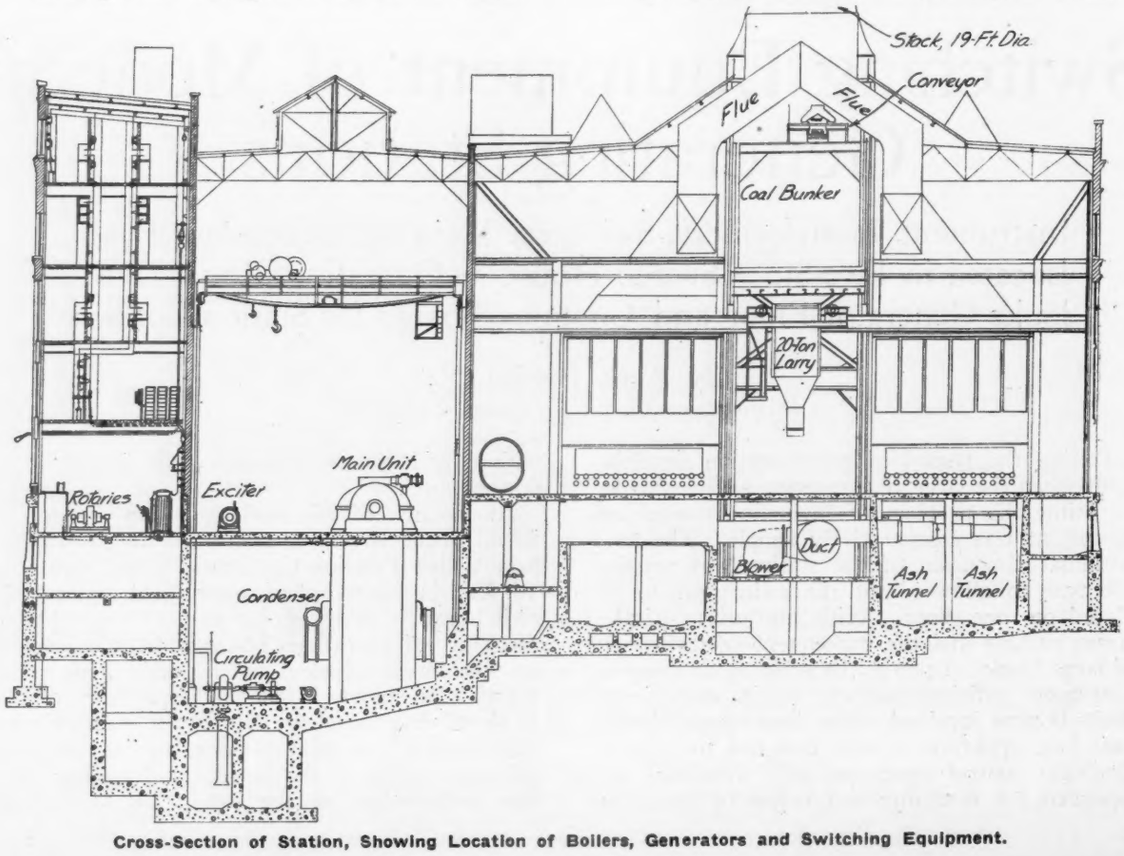
Panel Used for Control of 600-Volt Direct-Current Railway Circuits.



Operating Room Overlooking Generator Floor and Containing Control Panels.

cables from each of the two 12,500-kv-a. generators are taken directly to the second floor, where potential and current transformers are installed for measuring the output of each generator. On this floor the two generator buses are tapped for the auxiliary bus, and from here the two branches are carried to the third floor, to the generator disconnecting switches and oil circuit-breakers. On the fourth floor are the main buses, and on the fifth floor all the outgoing feeder circuit-breakers, disconnecting switches and instrument transformers are located. The circuits are then taken down the wall one and a half floors in open bus construction before entering the potheads of the conduit which takes them to the transforming equipment in the outdoor substation.

Although the switchgear is located on the several floors and in the outdoor substation, the ease and simplicity of maintenance and control are pronounced. The operating room floor, shown in an accompanying illustration, is designed with a windowed balcony so that the operator can view the generator room, while the switchboards and control desk are so located as to be visible from any point in the room. Another illustration gives a more detailed view of the generator control desk, located in the windowed balcony, than that showing the entire room. Exciter and generator field switches are located in the turbine room, but are controlled and are visible from the operating room. In addition to the various remote-control push buttons, each generator section of the control desk is equipped with a set of illuminated signals for sending directions to the generator attendant. These signals operate



Cross-Section of Station, Showing Location of Boilers, Generators and Switching Equipment.

Installation of Switching Equipment in Rivesville Central Station

Oil Circuit-Breakers and Transformers Mounted on Concrete Piers.

Remote-Control Bench Board for Operation of Two 12,500-Kv-a. Generators.

View Showing Typical Installation of Circuit-Breakers and Buses.

Exciter Panel Located in Gallery Above Turbine-Room Floor.

in the usual manner; that is, the pressing of a button on the control desk illuminates the respective signal lamp at the generator. The lamp stays lighted until the attendant observing it presses his button and extinguishes the light. This system also has the advantage that it can be worked either way, allowing the generator attendant to signal the operator if he so desires.

Opposite the control desk is located the transformer and feeder boards. At the far end of the room is installed the auxiliary board with panels for the control of the d-c. end of the exciters, the voltage regulator, storage batteries and for mounting the totalizing wattmeter and graphic instruments. This board is plainly shown in the general view of the operating room.

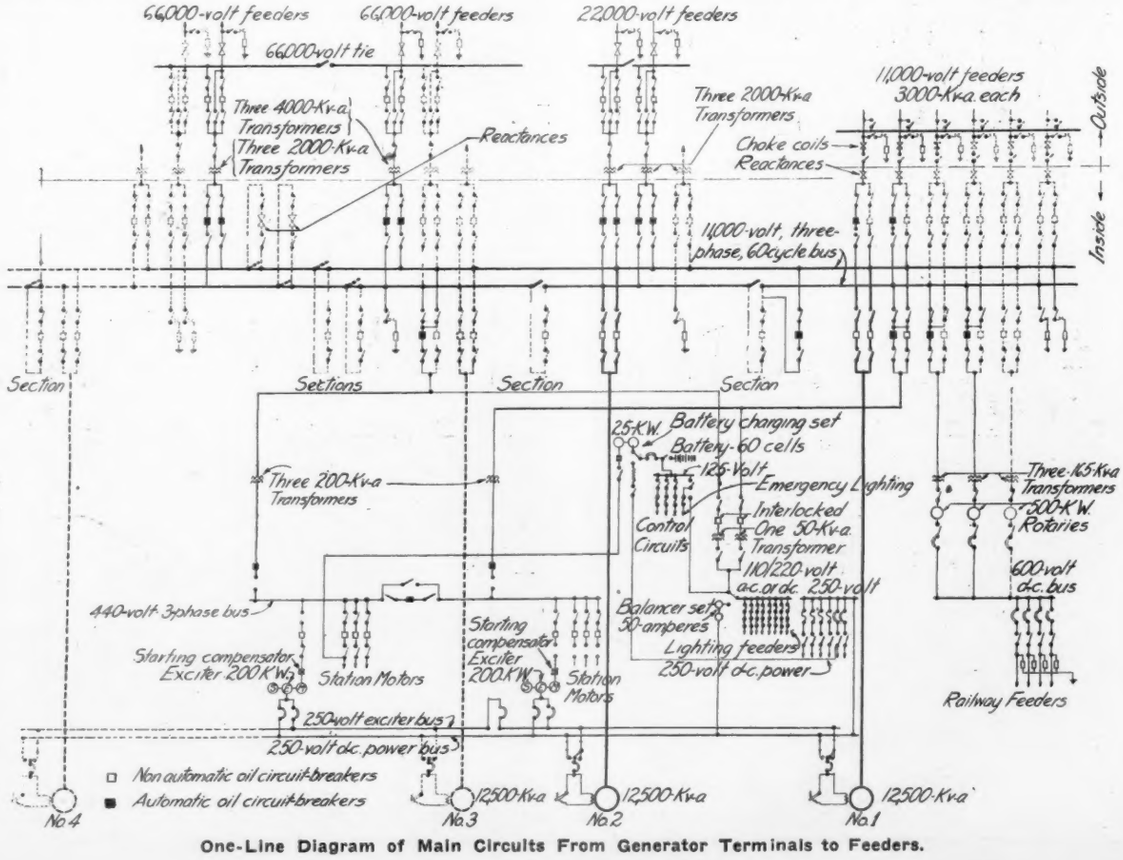
One-Line Diagram Serves as Guide in Emergency Operation.

One of the main features of the switching equipment is the layout of the control circuits on the desk, transformer and feeder boards. The several circuits, as shown on the accompanying one-line diagram, are represented by miniature buses. With this layout the operator can easily trace circuits in case of trouble and thereby expedite action with a minimum of error. Since the miniature buses representing circuits of different voltage are finished differently, the 11,000-volt bus being finished in copper, the 66,000-volt bus in brushed brass, the 22,000-volt bus in mottled oxidized copper and the low-tension station, auxiliary bus in gun metal, it is easy to distinguish the portion of the system being manipulated. In addition to this safeguard a one-plug synchronizing system is used, each circuit-breaker control being provided with a separate synchronizing receptacle with extra contacts for closing the operating circuit of the breaker. Wiring of synchronizing receptacles is so arranged that no breaker can be closed unless the plug is inserted so that the synchronoscope indicates phase relations on both sides of the breaker.

Principal Features of Emergency Station-Lighting System.

Protection against the station being in total darkness in case of a shutdown is provided for in a well-designed emergency and station-lighting system. Normally, the emergency and lighting feeders are fed directly from the 11,000-volt bus through one of two 50-kv-a. transformers. In case of a complete station interruption the emergency lights are automatically fed from the storage battery by the operation of a double-throw switch. While the regular lighting feeders can be supplied from the 250-volt d-c. power bus, the operation of a double-throw switch on the service board closes a contact which starts a 50-ampere balancer set. By means of a relay the circuit to the feeders is not allowed to actually close until the balancer set has attained full speed. The balancer set is necessary because of the fact the d-c. power bus is operated at 250 volts while the lighting system is arranged for 250-125-volt three-wire operation. The storage battery can be charged either from the a-c. source of energy through a motor-generator set or from the 250-volt d-c. power bus.

Service and railway switchboards are located on the first or turbine floor of the switch building as shown in the diagram. At present there are two 500-kw., 600-volt d-c. rotaries installed for supplying railway service. Accompanying illus-



One-Line Diagram of Main Circuits From Generator Terminals to Feeders.

trations show the exciter boards and field control located in the turbine room, the method of installing static discharges, and the general type of construction used for the main circuit-breakers and bus structure. Each leg of the three-phase circuit-breakers is inclosed in a separate compartment or cell.

Concrete piers are used to raise the footings of the outdoor structure to a point above the high-water mark of the river. The outdoor structure is plainly shown in the general view of the plant, the equipment for coal handling being shown as well as that for electrical service. The basis of this station layout was an initial installation of two 12,500-kv-a. units, provision being made for future extensions. For the 11,000-volt circuits electrically operated type O1 circuit-breakers are employed and type G1 breakers are used for the 22,000-volt and 66,000-volt circuits. A total of nineteen 600-ampere type O1 breakers were furnished for the entire plant. In addition, there was the usual complement of type E10 oil circuit-breakers for generators neutral and F3 breakers for the 440-volt station-service distribution. All circuit-breakers are provided with two 15,000-volt disconnecting switches, one being located on each side of the breaker. Two 66,000-volt, two 22,000-volt and two 11,000-volt type AK lightning arresters and necessary current and potential transformers are also installed in the station.

This station, together with the switchgear as described above, was designed and erected under the direction of Sanderson & Porter, engineers, New York City. The entire switchgear and power transformers were furnished by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

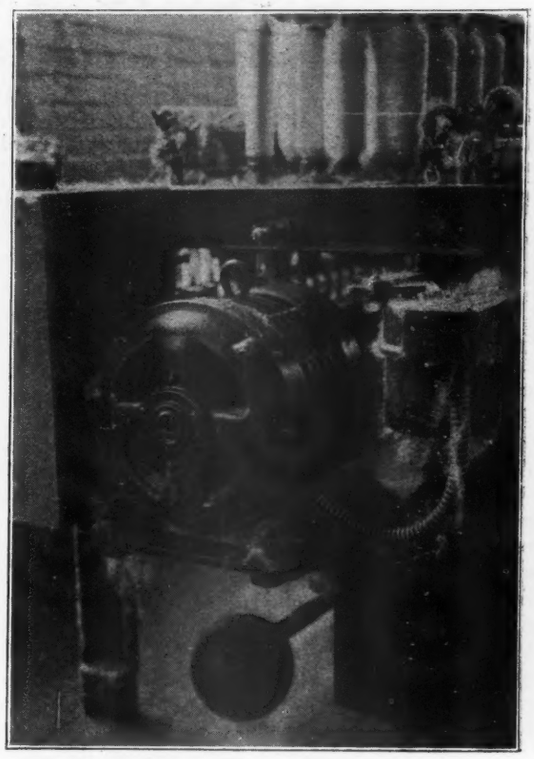
MOTORS ARE ATTACHED DIRECTLY TO TEXTILE MACHINES.

Change From Belt to Individual Drive Accomplished Without Affecting Operation or Control of Spinning Machines.

In changing from the group drive to individual motor drive of 128 ring spinning frames at the Indianapolis (Ind.) Bleaching Co. some time ago,

Group of Ring Spinning Frames, Motive Power for Which Was Changed to Individual Drive.

the motors were attached directly to the frames without moving the existing machines. Previously, the machines were driven through line shafts attached to the ceiling. These line shafts



Method of Mounting Textile Motor, Showing Inclosed Cabinet for Switch and Fuses.

were removed and the motors were installed without disturbing the layout of the plant. The accompanying illustrations show how these motors are arranged, each motor being mounted on a cast-iron bracket attached to the end of a spinning frame. They are so arranged as to be connected directly to the cylinders on the Lowell frames. Even the diameter of the cylinders did not have to be changed, as the motors gave exactly the correct speed desired for operation of the machines.

These motors are 5-hp., three-phase, 550-volt, 60-cycle, 1150-r.p.m. Westinghouse textile motors, and are controlled by drum-type switches with shipper-rod control formerly used with the belt drive. The switch is attached to a shipper-rod on the frame so that the motors and machines can be easily started and stopped from either end. By the utilization of this control the change had no effect upon the operation of the machines.

Directly below each motor switch the switch and fuses are mounted in an inclosing steel cabinet. Connections from the switch and fuse box to the motor are made with wires in flexible steel conduit.

By the installation of the motors driving the machines directly, great improvement was made in the working conditions. All shafting was eliminated, which resulted in better lighting and decreased noise. Furthermore, the maintenance of shaft bearings was obviated, and the possibility of oil dropping on the frames was removed.

Fundamentals and Economics of Electric Transmission

Eighth of a Series* of Articles Giving a Review of Electric Power Situation — Preliminary Survey of Line Necessary — Application of Kelvin's Law—Determination of Economic Line Voltage

By ALFRED STILL

An overhead electric power line consists of bare wire conductors strung between insulators on poles or towers of sufficient height to provide proper clearance between the wires and the ground. It would thus seem that no engineering problems of any magnitude would be encountered in planning and erecting an overhead transmission, and this is no doubt true of low-voltage lines of small capacity.

It is well, however, to bear in mind that just as any structure may be designed of ample strength if the question of cost be disregarded, so also might a transmission line be constructed with conductors of so large a size, insulators with so large a factor of safety, and supports so closely spaced and so strong that the electrical losses would be negligible and the risk of mechanical failure almost non-existent. But such a line would not reflect credit upon the designing engineer, who should always have before him the commercial aspect of the work he is engaged upon. He must so choose and design the various parts of the system that when these are combined and put into operation all economic requirements have been satisfied as nearly as possible.

Economic Conditions of Generating Machinery Fulfilled.

In the construction of electrical plant and machinery, such as generators, transformers and switching apparatus, the economic conditions are, as it were, automatically fulfilled, owing to the competition between manufacturers, each one of which is a specialist in his own particular line of business. This competion, it should be observed, is not merely in the matter of factory cost or selling price, but in factory cost plus efficiency and durability. It is not necessarily the cheapest or the most costly manufactured article that wins in the long run, but the one which is commercially best suited to the needs of the user.

The cost per mile of a finished transmission line, whether by overhead or underground conductors, is not all-important. It may frequently be said to be of importance only in so far as it influences the annual cost of the line, which annual cost is understood to include interest on the capital sum expended on the line. If a heavy section of copper is used for the conductors the loss of energy in overcoming resistance will be less than with a lighter section, but the initial cost will be greater. There is only one particular size of conductor which is economically the right size for any given line operating under definite conditions, and this is by no means easy to determine, notwithstanding the apparent simplicity of what is usually referred to as Kelvin's law.

It is commonly supposed that wood poles with pin-type insulators, spaced something less than 250 ft. apart, should be used on small power lines working at low or medium pressures, yet there are conditions under which light steel "A" frames or latticed poles may with advantage replace wooden poles. In some cases taller steel structures with long spans might even prove to be the better construction from the economical standpoint. On the other hand, when a large amount of power has to be transmitted over long distances at high pressure—in which case the suspension type of insulator is almost a necessity—it does not follow that tall, rigid, wide-base, steel towers, spaced about eight to the mile, should necessarily be adopted. Indeed, it is not an easy matter to decide upon the type of structure and average length of span best suited to particular conditions of load and distance and also to the character of the country through which the line will pass. Without a knowledge of the natural obstacles to be reckoned with, including the direction and probable force of windstorms and whether or not these may occur at times when the wires are coated with ice, the nature of the supports and the economical length of span cannot properly be determined. On the Pacific coast, where there is rarely, if ever, an appreciable deposit of sleet on overhead conductors, it is possible that the spacing of supports may generally be greater than in countries where the climatic conditions are less favorable.

Expenditure for Preliminary Survey and Calculations Justified.

As a general rule, it is certain that money spent on preliminary surveys and calculations before the work is actually started is well spent. It is a mistake to suppose that a transmission system of any magnitude can be erected economically and give good service unless as much engineering knowledge and judgment enters into its construction as into the manufacture of the generators and transformers.

It is well to bear in mind that the introduction of automatic switches and similar devices designed to save labor and insure the rapid changing over of the load from a faulty section to a sound section on a duplicated transmission line is liable to lead to unlooked-for troubles; and even the

*Preceding articles in this series appeared in the July 17, Aug. 7, Aug. 21, Sept. 4, Sept. 18, Oct. 2 and Oct. 16 issues of Electrical Review.

generous provision of lightning arresters, especially on the extra-high-tension lines, is not always good policy. Simplicity and the avoidance of unnecessary joints, rubbing contacts (as in switches or cutouts), fuses in the stations, and spark gaps or arresters along the line should generally be aimed at; but there will always be exceptions to such rules.

There was much speculation and little sound business connected with many of the earlier power schemes. A considerable change in this respect has been noticeable in recent years, and the investor is inclined to look more closely into the commercial possibilities of a new undertaking than at the time when some of the pioneer water-power developments were promoted.

Meaning of Kelvin's Law as Applied to Transmission Economics.

We frequently hear of Kelvin's law in connection with the economics of power transmission, and, although the law as originally stated may not always be applicable, in its broader sense it should be the basis of all transmission line calculations.

The necessary ohmic resistance of the conductors is the principal cause of energy loss in electric power transmission. For a given section of conductor the power dissipated in the form of heat in overcoming the ohmic resistance is proportional to the square of the current. A definite amount of power can therefore be transmitted with less loss when the voltage is high than when it is low; but, on each particular transmission, there is a limit to the pressure beyond which there is nothing to be gained in the matter of economy. This limit is determined by the cost of generating and transforming apparatus, which will be greater for the higher voltages, by the greater cost of insulators and of the line generally—owing to the larger spacing required between wires—and, also, when extra high pressures are reached, by the fact that the power dissipated is no longer confined to the I^2R losses in the conductors, but occurs also in the form of leakage current over insulators and in the air surrounding the conductors.

When conductors have to be provided to carry a current of known amount they may be of large cross-section, and therefore of high initial cost, but of so low a resistance that the I^2R losses will be small; or they may be of small cross-section and high resistance, the capital expenditure on which will be small, but in which the I^2R losses will be large. The economical size of conductor for any given transmission will therefore depend on the cost of the conductor material and the cost of the power wasted in transmission losses.

If it is assumed that the cost of poles or towers, insulators and other materials (apart from the conductors themselves), including the labor on erection and stringing of wires, is independent of the actual size of conductor, then the only variable item in the capital expenditure is directly proportional to the cross-section (or weight) of the conductor, and since the I^2R losses (for a given current) are inversely proportional to the conductor cross-section, the law of maximum economy (which is Kelvin's law) may be expressed as follows:

The most economical section of a conductor is that which makes the annual cost of the I^2R losses equal to the annual interest on the capital cost of the conductor material, plus the necessary annual allowance for depreciation.

The cross-section should, therefore, be determined solely by the current which the conductor has to carry and not by the length of the line or an arbitrary limit of the percentage full-load pressure drop. If there are reasons which make a large pressure drop undesirable, then, if necessary, economy must be sacrificed, and the line calculated on the basis of regulation only. It will, however, generally be found that the economic conductor will give reasonably good regulation.

Methods and Formulas for Calculating Economic Voltage Drop.

Without attempting to enter into refinements of calculation or even explain in detail their derivation, it is proposed to give one or two simple formulas* which may be used to determine the most economical size of conductor.

When the size of a conductor is determined by the application of Kelvin's law, the ohmic drop of pressure per unit length of conductor is independent of the actual voltage of the energy to be carried, and therefore bears no definite relation to the total amount of energy to be transmitted. The economic data and assumptions alone determine the ohmic drop in volts per unit length of conductor, and this will be a constant quantity whatever the number of conductors or system of electric transmission adopted, the total amount of energy to be transmitted, or the voltage ultimately decided upon.

The most economical loss of voltage or potential drop per mile of conductor, due to the ohmic resistance of the wire, is given by the formula

$$E = k\sqrt{\frac{a \times p}{c}}$$

in which k is a numerical constant equal to 9.35 for copper and 6.57 for aluminum.

p is the price paid per 100 lbs. of the conductor.

c is the cost per kw-yr. of the energy wasted in the transmission lines.

a is the percentage to be taken to cover the annual interest and depreciation.

The corresponding formula giving the economical size of conductor in circular mils per ampere of current to be carried is:

$$m = k'\sqrt{\frac{c}{a \times p}}$$

where $k' = 5800$ for copper, and 13,400 for aluminum.

Having ascertained what will be the most economical ohmic drop of pressure per mile of conductor without reference to the total amount of power to be transmitted, the size of the conductor cannot be determined unless the value of the current is known, and this will depend upon the

*For derivation see p. 52, "Electric Power Transmission," by Prof. A. Still.

pressure at which the energy will be transmitted.

The writer has found the following formula useful in preparing preliminary estimates, the line voltage obtained by use of the formula agreeing generally with modern practice.

$$\text{Line pressure (kilovolts)} = 5.5\sqrt{L + \frac{\text{kw.}}{100}}$$

This empirical formula may be used for estimating the probable economical transmission voltage on lines over 20 mi. in length. The symbol L stands for the distance of transmission in miles, while kw. stands for the estimated maximum number of kilowatts that will have to be transmitted over one pole or tower line.

Given the amount of power to be transmitted and the length of line, one can with the aid of this formula decide upon a standard voltage and proceed with the calculations for current and size of conductor. But it is necessary always to bear in mind that a transmission line cannot be considered by itself; it must be treated as part of a complete scheme of transmission and distribution, and the best voltage to use on any given system can generally be arrived at only by a method of trial and error, taking into account the cost of the various parts of the complete system as influenced by alterations in the transmission voltage.

The calculation of the proper size of conductor to use on any transmission line would appear to be a very simple matter, but although the formulas here given are extremely simple and easy to apply, the real trouble lies in the fact that the quantities represented by the symbols a, p and c are not easily estimated.

For instance, before we are able to estimate the current in the conductors, we must know what is to be considered as the average amount of energy transmitted by the wires and over what term of years this average shall be taken. This will in its turn have some influence on the cost of the wasted energy (the item c in the formulas). Again, the type of generating plant, whether coal-consuming or hydroelectric, and the question as to whether or not there would be a market for the energy if this were not wasted in transmission, must very greatly affect the amount to be allowed for the item c in the formulas.

A proper value for interest and depreciation (the item a) is less difficult to obtain, although many considerations must enter into its determination. The cost of conductor material (item p) will of course be based on market quotations.

Choice of Economic Line Voltage Depends on Different Cost Factors.

It is a mistake to suppose that the proper line voltage depends merely upon the distance of transmission. Very high pressures are not always economical even when the distances are considerable. On the other hand, short-distance transmission schemes frequently operate at too low a voltage. When figuring on the best voltage for any particular scheme the capital cost of all buildings and apparatus, which is liable to be influenced by the transmission-line pressure, together with all operating and maintenance charges which may be similarly influenced, must be taken into account. It will usually be found convenient to reduce all such costs or differences of cost to the basis of annual charges.

Before deciding upon the proper transmission voltage the first cost, life, annual maintenance and operating charges of every portion of the complete undertaking which may be affected by a change in the transmission voltage must all be considered. These costs, preferably worked out on an annual basis, should be arranged in tabular form under two or more selected voltages in order to determine which of these voltages will correspond to the smallest total cost.

The annual charges on the line conductors will vary inversely as the voltage and will therefore always be less for the higher pressures, but the cost of supporting structures and insulators will increase, as well as that of transformers and switchgear. To a small extent the cost of buildings for generating stations and substations will also be greater for the higher pressures, so that a particular value is soon reached at which the saving in cost of conductor material and I^2R losses is overbalanced by the increased cost of other portions of the complete undertaking.

Economies of Overhead and Underground Transmission Compared.

Apart from such questions as the unsightly appearance of overhead lines in certain thickly populated districts, and the possibly greater danger to life when wires are carried overhead, the decision as to whether or not transmission lines or portions of transmission systems should be carried underground rather than overhead should properly be based on economic considerations. There are certain insulation difficulties in the way of using underground cables for very high pressures, especially on alternating-current systems. Generally the first cost of installing an underground system is higher than for the equivalent overhead system, but nevertheless there may be purely economic advantages in transmitting underground.

In districts where thunderstorms or windstorms are of unusual violence, underground transmission might insure better continuity of service, and the reduction of the annual losses caused by inefficient or interrupted service might easily outbalance the annual charges to cover the increased first cost of the cable systems.

Just as we may have corona losses on overhead lines in addition to the resistance losses, so we may have additional losses in the dielectric of underground cables. The ohmic resistance of the insulation being very high, the losses when a high-tension cable is used on a continuous-current circuit are very small, but with alternating currents there is a further loss due to dielectric hysteresis, which is proportional to the frequency of alternation of the electrostatic field.

The total charging current in a cable may be considered as made up of two components, one being the true capacity current of which the phase is exactly 90 deg. in advance of the impressed e.m.f., the other being the "energy" component in phase with the e.m.f. This last component is relatively small, being due to what is known as dielectric hysteresis and not to the ohmic resistance of the dielectric, the effect of which is usually negligible.

Development of National Water-Power Resources

Analysis of Developed and Undeveloped Water Powers—Influence of Passage of Federal Water-Power Bill—Substitution of "White Coal" for "Black Coal"—Railroad Electrification to Save Coal

By C. D. WAGONER
Publicity Department, General Electric Co.

After ten years of contention and a serious drain on the coal and oil fields throughout the country, the door was recently thrown open for "white coal" to serve industry and the home by the passage of the water-power development bill. The vast water powers of the country may now be utilized.

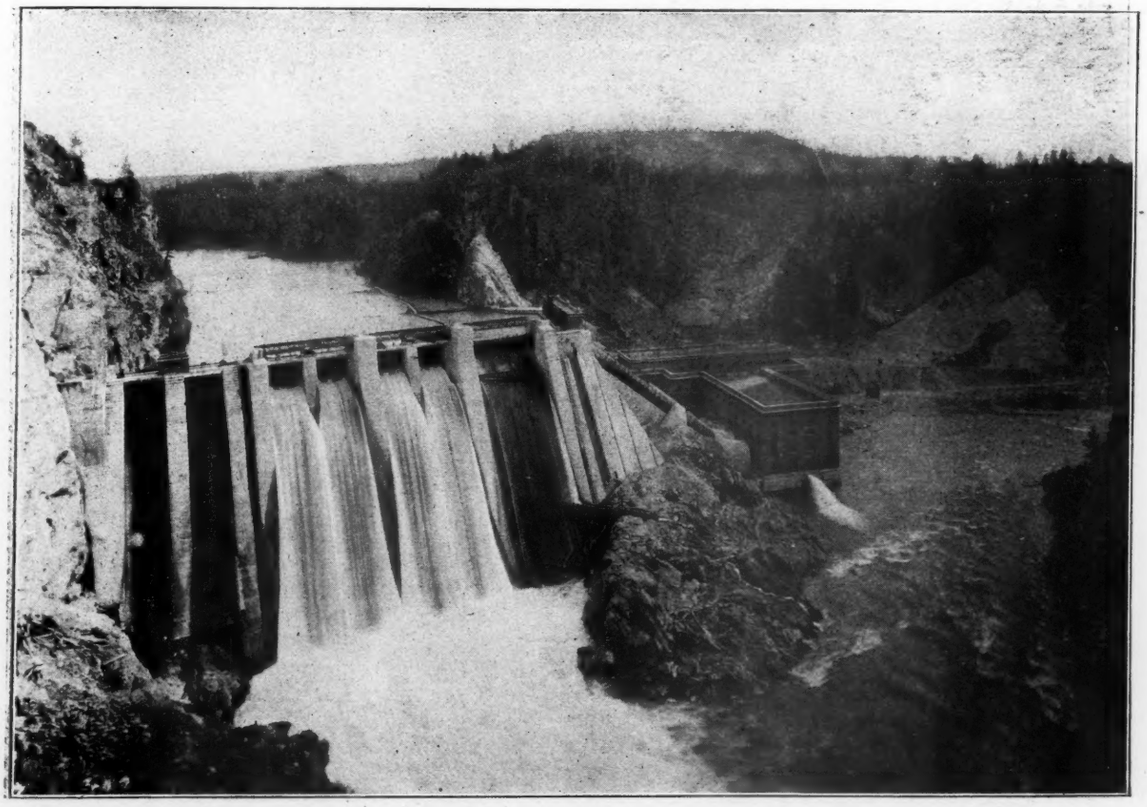
About 50,000,000 hp. comprises the total now in use in the United States. It is conservatively estimated that as much more can be developed by utilization of the water-power resources. The Department of the Interior has placed the potential water power at 60,000,000 hp., of which but 10,000,000 is now developed, saving the country upwards of 33,000,000 tons of coal annually.

It is not contended that water power can take the place of coal. In some instances a substitution for "black coal" cannot be made, but as a supplement it will add greatly to the total, reduce the average cost per unit, set electricity to work in the home far more extensively than at present, and bring about such public comforts as the substitution of electricity for coal has done on some of the larger railroads.

Water Power Cannot Substitute for Coal in All Cases.

Dr. Charles P. Steinmetz, who amazed the world a short time ago by his map and figures showing the total water power of the country compiled by checking up the total rainfall with the various elevations of the United States, warns against too general a belief that the water-power resources of the United States may ever completely replace the use of coal and oil for power purposes.

On the basis of an exhaustive investigation he states that while the new federal legislation is a big forward step in fuel conservation, the maximum possible hydraulic energy of the nation is little more than the total energy which we now produce from coal, and is about equal to the pres-



Plant of Washington Power Co. at Long Lake, Spokane River, a Typical Hydroelectric Development in the West.

ent total energy consumption of the country, including all forms of energy.

"This is rather startling," said Dr. Steinmetz. "It means that the idea that when coal once begins to fail we may use the water power of the country as the source of energy is and must remain a dream because if all our potential water powers were developed it would not supply our present energy demand. Thus, hydraulic energy may and should supplement that of coal, but can never entirely replace it as a source of energy. This probably is the strongest argument for efforts to increase the efficiency of our methods of burning coal.

"Obviously, of course, we can never hope to develop more than a part of the maximum potential energy of the water, and I merely cite these figures to show that our water-power resources if developed to theoretical perfection would still fall short of meeting the energy demands of the country today."

Millions of Horsepower Going to Waste at Niagara Falls.

From Niagara river but 26% of the total flow is diverted for generating electricity. Engineers estimate that 60% might be diverted without marring the scenic beauty of the falls.

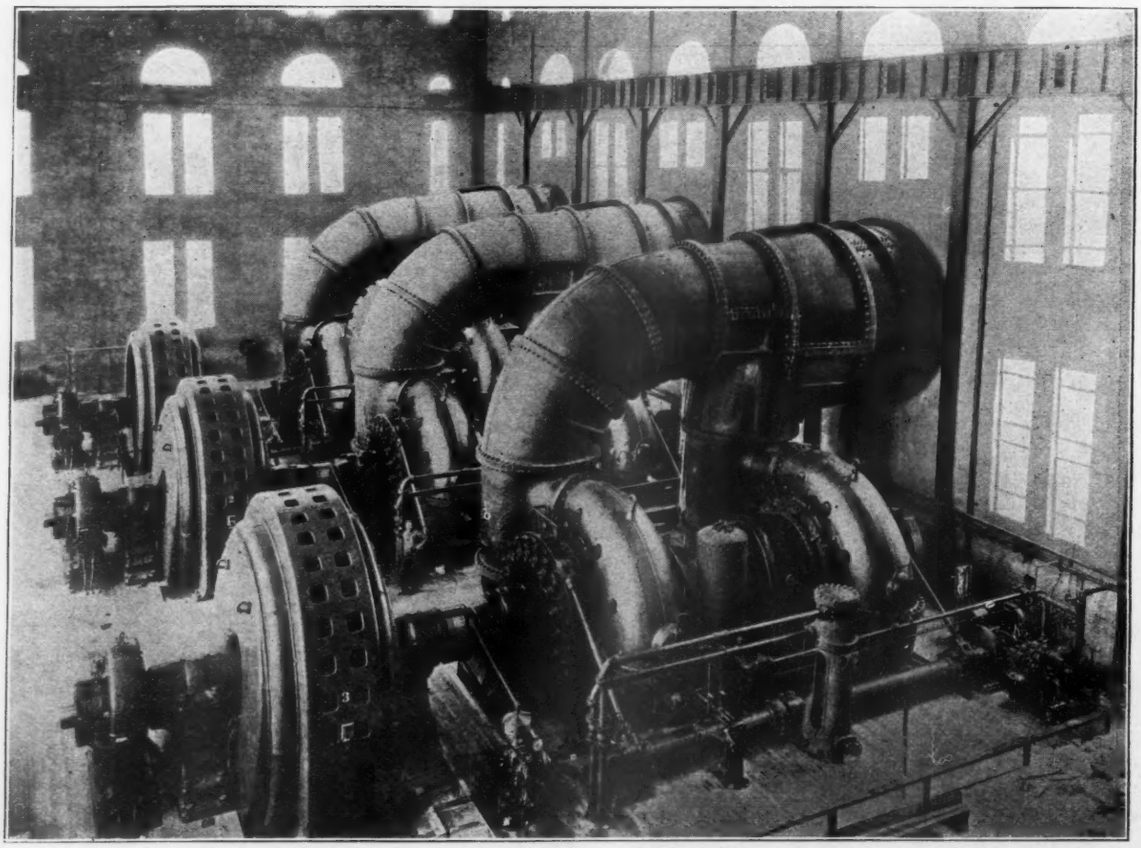
There is practically no variation in the flow of this river throughout the year, making it ideal for hydroelectric development. Millions of horse power are now going to waste. A treaty with Great Britain limits the amount of power that can be developed now.

Other engineers estimating the effect of the federal bill claim that it will permit development of at least 4,000,000 hp. of additional electrical energy, and that already applications for the use of 750,000 hp. have been filed in Washington. The development of federal water-power sites will, in addition to this, open up 4,000 mi. of rivers to navigation.

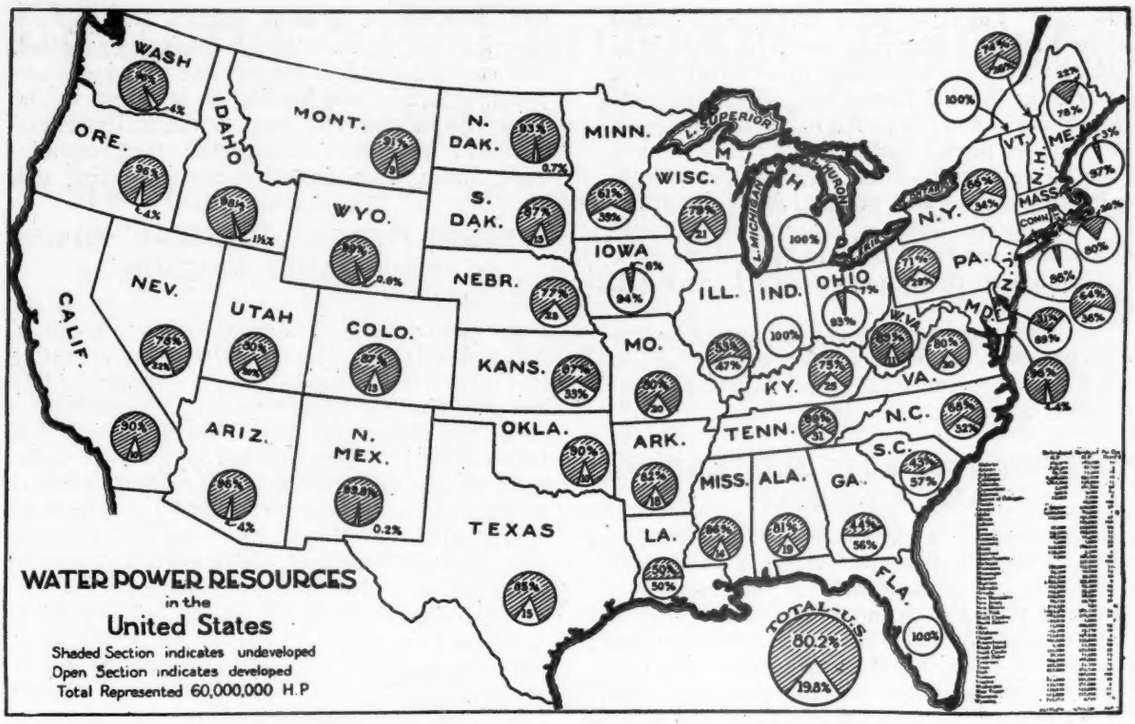
Use of Water Power Will Supplement Coal and Oil.

In this country the production of oil has already passed its peak, and in the world as a whole it will in a comparatively few years become of diminishing importance as a power producer, according to experts. There are still large reserves of coal in this country, though the greater ones are in the distant West, and the coal-producing countries are still far from exhaustion. But with the doubled price of coal, due in part at least to the increased cost of getting it out of the ground, coal-made power will be on the steady rise, it is predicted. In the creation of power, coal and oil are consumed; they cannot be replaced and therefore, it is asserted, the country which in future competition depends wholly or in great part on coal and oil power will be in a position of increasing disadvantage.

The railroads of the country are one of the greatest coal-consuming agencies. According to the latest statistics available, those for 1918, the steam railroads in the United States consumed in the 12-month period 163,000,000 tons of coal and 45,700,000 bbls. of oil. Assuming 3.5 bbls. of oil to be equal to 1 ton of coal, then the steam railways in 1918 burned the equivalent of 176,-



Three 17,400-Kv-a., 4000-Volt Water-Turbine-Driven Generators in Plant of Washington Power Co. at Long Lake.



Analysis of Developed and Undeveloped Water-Power Resources by States.

000,000 tons of coal; and every 1,000 tons of freight moved a mile called for the expenditure of 290 lbs. of fuel. These figures mean nothing to the layman unless contrasted with those of another and much more efficient form of tractor —the electric locomotive or "white coal" engine. Operative data of an authentic character reveals that 1,600 tons can be hauled 1 mi. electrically with energy produced at a modern generating station on a consumption of only 100 lbs. of coal.

There are in service on various railroads in the United States approximately 63,000 steam locomotives. Fully a third of all the coal burned in their boilers is wasted in what is termed "standby losses." This is explained by A. H. Armstrong of the General Electric Co. in the following manner: "From the moment of firing up to the completion of a day's duty, the steam engine demands continual stoking of coal to keep its boiler hot, whether it is doing useful work in hauling its rated load up grade or on level track, or whether it is standing for hours at terminals or on passing tracks, coasting down long gradients or standing in the roundhouse with fires banked, but still burning coal a a rate of at least 300 lbs. or more an hour."

Utilization of Water Power Results in Large Savings of Coal.

To make matters worse, each locomotive is an isolated plant. The firemen are good, bad, and indifferent; but the average performance of this vast army of coal handlers is poor compared with the fuel-burning efficiency possible in a well-managed central station.

This is not the whole story of the price paid for steam traction. Not only are the steam locomotives using up 25% of all the coal mined in the country yearly, not to mention a great deal of fuel oil, and doing this inefficiently, but the distribution of railway coal requires a tonnage movement amounting to about 20% of the total revenue-producing freight ton-mileage of land lines. This is not hard to understand if we recall that there is, first, the coal car's journey from the mine to the railway coaling station; next, the fuel's travel on the engine tender; and then the mileage of the empty coal car bound back to the colliery and hauled, of course, by steam power. Could the steam locomotive be eliminated, and electric haulage employed instead, the amount of freight handled in 1918 could be moved and still a saving of probably 123,000,000 tons of coal could be effected.

Although the war saw an increase in horsepower used in the United States, according to an expert at Washington, the demand is now 15% higher than it was then. California leads the remaining states in the development of water power, the hydroelectric plants being linked up with the steam plants in one big system that extends from southern Oregon to the lower part of

Water-Power Development Contemplated in Different States.

Water-power development on navigable streams in the United States, contemplated under the new federal bill, shows a total of more than 2,000,000 hp. as follows:

State.	Hp.
Washington	660,000
Montana	100,000
Minnesota	30,000
Iowa	60,000
Maryland	110,000
Massachusetts-Connecticut	30,000
Georgia	158,000
Alabama	590,000
Tennessee	25,000
Kentucky	26,000
North Carolina	200,000
Virginia	55,000
South Carolina	78,000
	2,122,000

California. Engineers point to this as a model for the country. Electrical power is cheaper in California than anywhere else in an equal extent of territory, and the homes into which electrical wires do not run are reported to be comparatively few. In the thickly settled rural districts most of the farmers are provided with electricity, finding it cheaper than man power. Mills for grinding grain on the farm, washing machines, sewing machines are run by electricity. In the place of the oil lamp the farmer reads by an electric light.

This beginning of a new era in power development promises to result in one of the biggest booms the electrical industry of the country has yet experienced.

WESTINGHOUSE BUYS INDEPENDENT LAMP & WIRE CO.

Announcement has been made by the Westinghouse Electric & Manufacturing Co. that negotiations are being closed for the purchase of the plant and property of the Independent Lamp & Wire Co., Rochester, Pa. Although this plant was formerly used for the manufacture of glassware, the Westinghouse company plans to utilize it for the production of micarta materials of all kinds, as well as repair parts for electrical machinery. The plant has a total floor space of about 130,000 sq. ft.

UNDERWRITERS REINSPECT INSTALLATIONS IN BALTIMORE.

Inspectors Co-operate with Central-Station Company and Contractors to Eliminate Fire and Life Hazard.

Reinspections of electrical equipment are being made in Baltimore, Md., with a view of correcting defects and reducing the life and fire hazards which the inspections show to exist to a great extent. The Association of Fire Underwriters of Baltimore, which is doing this work, enlarged its electrical department last May by the addition of ten inspectors, these men being selected after careful examination as to character, experience and ability; none were selected who had an experience in the business of less than eight years as practical electricians.

Merchants and manufacturers in Baltimore are giving their attention to the efforts made to eliminate electrical defects, and some of them are requiring of electrical contractors certificates of approval from the Association of Fire Underwriters, the thought being that they will then know that installations are made in accordance with the National Electrical Code, supervised during the course of construction. In the past this work was practically in charge of the municipal inspection bureau consisting of two men whose duty it was to supervise all electrical installations in the city, a task quite beyond their capacity if due regard is given to conservation of life and property.

The Consolidated Gas, Electric Light & Power Co. of Baltimore requested the state public service commission to grant permission for it to select the Association of Fire Underwriters of Baltimore as its agent to inspect and approve electrical installations before service is supplied. The contractors of Baltimore are showing a co-operative spirit and lending their effort in the work. From June 1 to Aug. 31 the underwriters' electrical inspectors reinspected 1529 installations, finding 1266 defective, and correcting 488.

INTERNATIONAL COMPANY OPENS NEW RADIO STATION.

A new wireless station has been opened by the International Radio Telegraph Co. at Siasconset, Nantucket Island, Mass. Current for operating this plant is obtained from a storage battery which is charged when necessary by means of a generator driven by a gasoline engine. The transmitter is of the spark-gap type, of 2-kw. capacity and is equipped for operating on either a quenched spark gap or a rotary synchronous spark gap. The frequency of the radio motor-generator set is 500 cycles with a sparking rate of 1000 per sec. The current in the antennae circuit for 2-kw. input is 15 amperes. The receiver is adapted for either damped or undamped waves over a range of wave lengths of from 300 to 3000 meters.

TO CO-OPERATE IN AIDING ENGINEERING FOUNDATION.

The council of American Society of Mechanical Engineers and the board of directors of American Institute of Mining and Metallurgical Engineers have adopted resolutions to co-operate with the officers of Engineering Foundation and the civil, mining and electrical engineering societies in promulgating a plan for increasing the endowment of Engineering Foundation.

COMPOSITION OF HIGH-INTENSITY SEARCHLIGHT ARCS.

Quantitative data on the color and spectral distribution of energy of modern searchlight arcs, together with spectroscopic analysis of the carbons, are given in Technologic Paper 168, entitled "Color and Spectral Composition of Certain High-Intensity Searchlight Arcs," published by the Bureau of Standards, Washington, D. C. Methods of measurement are also described.

GOODWIN AND CHASE SPEAK BEFORE BUFFALO ELECTRIC CLUB.

About 300 members of the Electric Club of Buffalo, N. Y., attended a meeting Nov. 5, at which the principal speakers were William L. Goodwin and Samuel Adams Chase. Co-operation within the industry and the opportunities for electrical trade were subjects under discussion.

AMALGAMATION OF JAPANESE ELECTRICAL ENTERPRISES.

With the object of stabilizing the electrical industry, the Japanese government intends to amalgamate all electrical enterprises. It is believed that this blending of plans and enlarging of enterprises will not only render the exploitation of water power easier and more economical, but will simplify the raising of capital.

Features of European Insulator Testing Practice

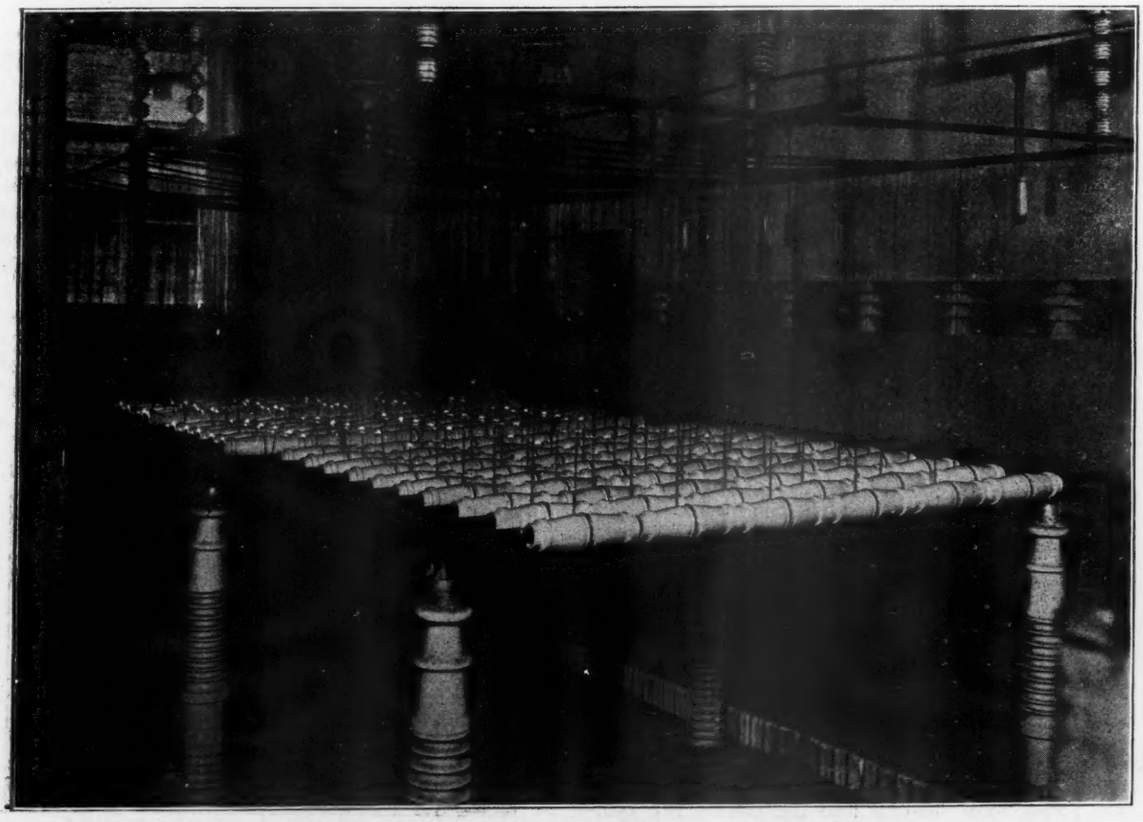
Two-Part Insulators of Pin Type Prove Satisfactory for Service Below 70,000 Volts—Tests Are Made of Electrical and Mechanical Properties of Individual Parts and Complete Assembled Units

By B. SCHAPIRA

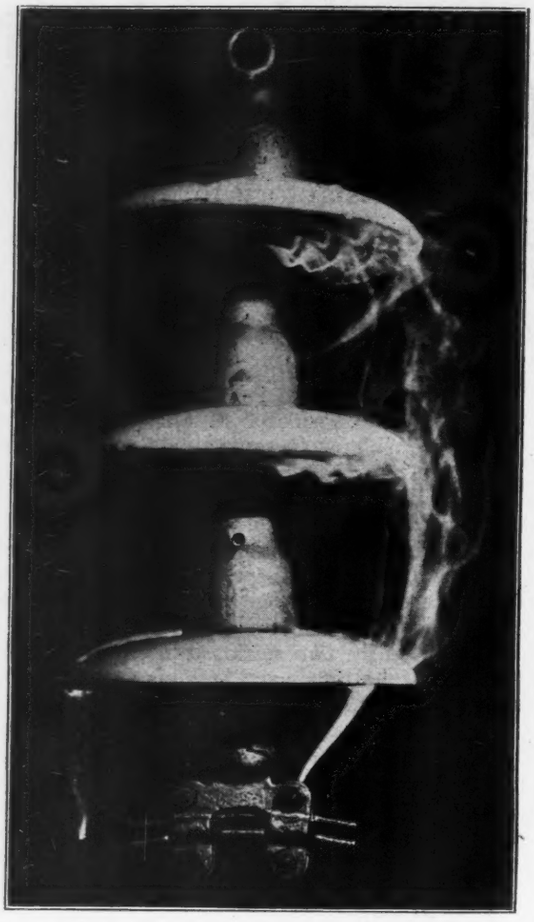
Stresses to which insulators are exposed in service are chiefly of a two-fold nature—mechanical and electrical. Consequently, insulators must be tested with both of these qualities in view, if the tests are expected to reveal their true service properties. The accompanying illustrations and descriptive matter will serve to show some of the detail of European testing practice as carried on in the Schomburg Works at Margarethenhutte, Germany.

For working pressures up to about 50,000 volts pin-type insulators are almost exclusively used, the kind used most extensively being known as the delta-bell type. An accompanying illustration shows the general character of an insulator of this particular kind. The two parts are made and baked separately and then are joined together by pure portland cement. Such construction has the advantage of allowing the use of thinner, and consequently more perfectly made, sections of porcelain. In addition, the two parts may be separately tested, the combined testing voltage being much in excess of what would be allowed for an insulator of only one part. A one-piece insulator for 10,000-volt service would be tested with a pressure of from 35,000 to 40,000 volts, while the upper section alone of a delta-bell insulator would receive a test of 35,000 volts. The pin section of such an insulator would be tested with a pressure of 25,000 volts, giving a total puncture test of 60,000 volts for the two sections of porcelain. Moreover, the cement laid between the two sections aids in distributing the electrical stresses and so adds further to the safety of such construction. Disruptive tests of these insulators are made under oil, it being impossible to raise the pressure to the required point in air without spilling over. An average of about 110,000 volts is required to puncture a well made unit. The actual tests applied depend upon the working voltage and are shown in the accompanying tables.

For insulators of 70,000-volt capacity three parts are cemented together, such construction



High-Voltage Bushings Mounted on Racks for Indoor Testing.



Three-Part Suspension Insulator Undergoing Rain Test at 135,000 Volts.

allowing the extremely high testing voltage given in the table. Each insulator is tested for a period of 15 minutes unless punctured before this time. If a puncture takes place, the testing is continued for a further period until the piece in question is rejected or stands the test for the full prescribed period. It is evident that after passing such tests the electrical safety of an insulator is quite satisfactory, this being particularly so with one of low voltage rating. However, with increasing dimensions the safety coefficient of delta-bell insulators diminishes steadily, due to the sliding-spark phenomenon. Surface-discharge tension is not exactly proportional to the dimensions, and voltages are limited by this discharge pressure. Consequently, insulators of this type are not used on

TABLE SHOWING AIR TESTS APPLIED TO DELTA-BELL INSULATORS.

Working pressure.	Test pressure.
10,000 volts.	60,000 volts.
30,000 volts.	100,000 volts.
50,000 volts.	135,000 volts.
70,000 volts.	200,000 volts.

voltage above 70,000, the dimensions and weight becoming excessive above this limit. Suspension-type insulators are used, as a rule, for voltage of 50,000 or over.

Three large testing fields are used for routine work, one field being equipped with transformers for 100,000-volt testing and the others for 150,000 and 200,000-volt testing, these values in each case being maximums. Each field is divided into two parts, one part being used for testing while the other section is being refitted with a new lot of insulators. The testing equipment for delta bells and other similar pieces consists of a large water basin covered over with a wooden top. Holes are made through the top of such size as to allow the inverted unit to extend into the water beyond its weakest point, that is, beyond the point of probable failure. Water is poured inside the inverted insulator and the transformer terminals are connected to the basin and to the inside of the various insulators. As many as 200 or more insulators may be tested in a single basin at one time by using an overhead bus system with brass chains to drop down for

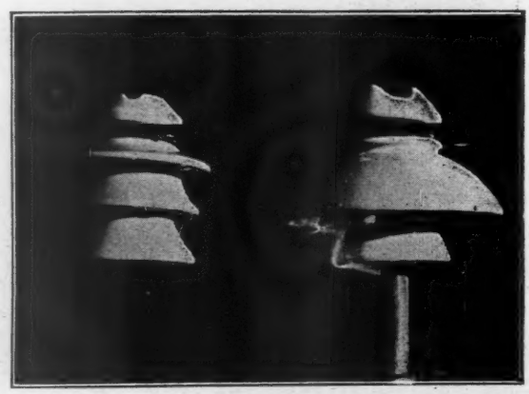
TABLE SHOWING OIL-TEST DISRUPTIVE VOLTAGES FOR DELTA-BELL INSULATORS.

Working pressure.	Disruptive strength.
10,000 volts.	110,000 volts.
30,000 volts.	140,000 volts.
50,000 volts.	170,000 volts.
70,000 volts.	200,000 volts.

connection to each unit. Former practice of using acidulated water has been found useless as ordinary water is a sufficiently good conductor at the voltages used.

Bushings Tested in Large Lots on Special Pipe Supports.

Bushings and insulators of a similar character are tested in a somewhat different manner. As may be seen from the illustration, bushings are slipped over metal pipes and arranged in large groups for testing. The supporting pipes are connected to one side of the testing transformers, and chains, as before, supply the connection from the outside of the bush to the transformer by means of a set of overhead buses. The voltage is raised slowly up to the point of surface discharge, it being the object to carry the test to a point where sparks appear. Such procedure, experience has proven, eliminates all defective pieces. As an evidence of quality each insulator is labeled with the testing voltage to which it was subjected. As stated before, further tests are made to determine punctures strength, the insulator being immersed in oil for this test. An accompanying table gives the disruptive strengths found for insulators of the delta-bell type. An accompanying illustration shows two types of delta-bell insulators being subjected to test un-



Two Styles of Pin-Type Insulator Undergoing Rain Test.

der rain conditions. Rain tests are conducted with special laboratory equipment intended to produce conditions similar to those prevailing in actual outdoor service. Fog is imitated and rain of varying intensity and from various angles is projected into the insulator carrying a live wire tied into the working slot or notch. Surface-discharge voltages are shown in an accompanying table. A static wattmeter with a measuring transformer, for direct connection with the high-tension circuit, is used to measure actual losses during the period of surface discharge. These losses are not of great importance when compared with other transmission losses, but are much increased for a short period during the beginning of a heavy rain.

Mechanical strength is fully as important as good electrical qualities in insulators for high voltage. Greater spans, involving larger and larger mechanical strains, are being used to decrease the number of expensive supporting structures. Thorough baking at a temperature of 1650 deg. C. produces porcelain of a quality hard and strong enough to resist any strains that may be applied to delta-bell insulators. The supporting pins are proportioned to bend over completely before the porcelain will fail. Tests of random samples are considered sufficient to prove the mechanical strength of a given lot of units.

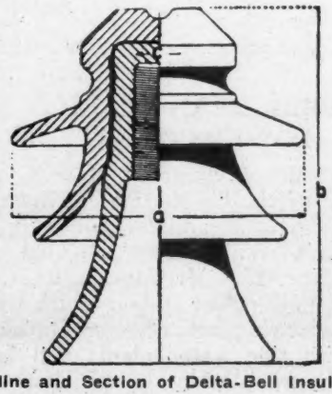
TABLE SHOWING SURFACE-DISCHARGE VOLTAGE OF DELTA-BELL INSULATORS.

Working pressure.	Dry discharge pressure.	Rain discharge pressure.
10,000 volts.	70,000 volts.	43,000 volts.
30,000 volts.	104,000 volts.	75,000 volts.
50,000 volts.	140,000 volts.	108,000 volts.
70,000 volts.	166,000 volts.	131,000 volts.

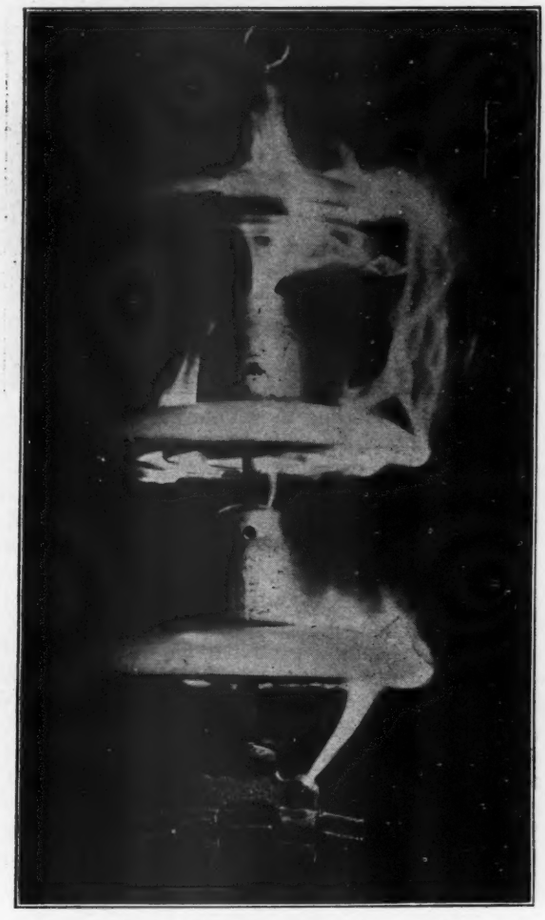
Electrical tests are made following mechanical tests in order to detect invisible defect or damage that may have been produced by the strain. The test figures shown in an accompanying table represent conditions where insulators are fitted to their pins with hemp packing. Cement and similar binding substances give greater strength, but are not recommended for the larger insulators because of the resultant restriction to the free expansion and contraction of the pin, binding material and insulator with changing temperature. The unavoidable consequences of such restrictions involve breaking of the insulator accompanied by interruptions of service and other undesirable difficulties.

As previously stated, insulators of the delta-bell type increase in size and weight more rapidly than in capacity, the 70,000-volt size being about five times as heavy as the 50,000-volt size. Suspension insulators, not being subjected to such variations, are more suitable for the higher voltages. However, because of the difference in the methods of supporting conductors, insulators of this type must be given more consideration from the mechanical point of view. Surface-discharge and puncture tests are made of the individual units of suspension insulators, the safety of this type as compared with pin-type insulators being quite high because of the number of units involved. Each individual part is tested up to its point of surface discharge, this being the highest voltage that can be obtained. The most important units of either suspension or strain insulators are subjected to tests of 80,000 volts. Since seven links are joined for a working pressure of 110,000 volts, the test strength of the entire string amounts to 560,000 volts. Following the electrical tests of the various parts metal fastenings are cemented in place, and mechanical testing follows the final setting of the cement. One mechanical testing device is arranged for routine work, all suspension-type insulators being subjected to a load of 6600 lbs. in this machine. Any link showing the slightest failure in this load test is rejected, and all others are labeled with the test data. Short electrical tests follow the mechanical test to detect any possible invisible damage.

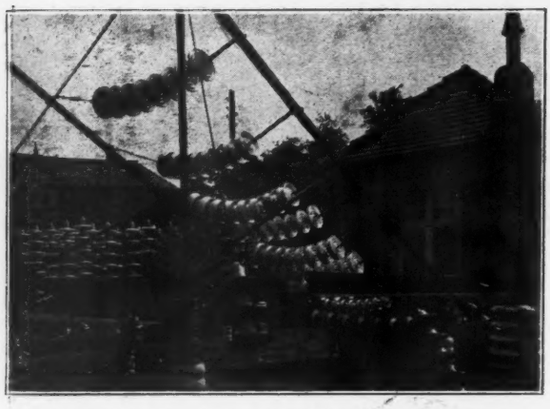
Random testing of units for disruptive



Outline and Section of Delta-Bell Insulator.



Three-Part Suspension Insulator Being Tested With 230,000 Volts.



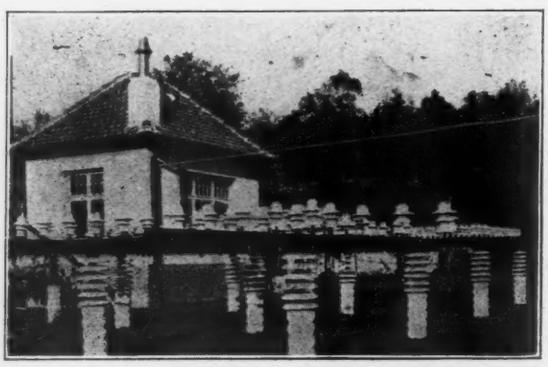
Suspension Insulators on Outdoor Testing Rack.

strength under oil serves as a guide in the maintenance of quality of product, disruptive strengths as high as 150,000 volts per unit being developed in this test. Suspension units selected at random are assembled in strings and subjected to surface-discharge tests under conditions approximately those met in actual service. Accompanying illustrations show such a string of three units subjected to dry testing at 230,000 volts and to rain testing at 135,000 volts. A seven-link chain will have a discharge voltage of 470,000 volts when dry and of 250,000 volts when subjected to a rain test. To determine actual open-air characteristics of insulators, a 200,000-volt overhead line is used to transmit power to an outdoor testing field. This line itself, which is provided

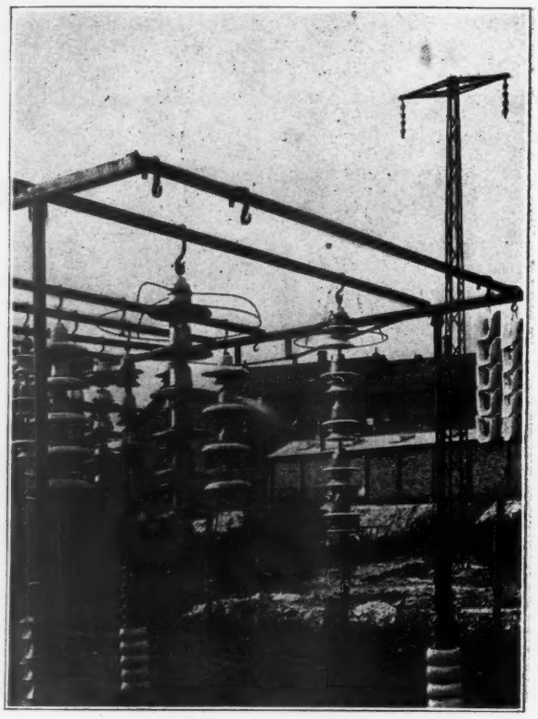
TABLE SHOWING LOADS APPLIED TO DELTA-BELL INSULATORS.

Working pressure.	Least breaking load.	Sagging load.
10,000 volts.	3500 lbs.	610 lbs.
30,000 volts.	5000 lbs.	1100 lbs.
50,000 volts.	6800 lbs.	1870 lbs.
70,000 volts.	8900 lbs.	2640 lbs.

with short strings of suspension insulators, serves as test equipment as well as for conducting power to the regular field test. It is not uncommon for sparks to appear on the insulators of this line under unfavorable weather conditions. Accompanying illustrations show pin-type, suspension and strain insulators set up for test in this field. Experiments are carried on with these various units to bring about improvements in existing types and to develop new designs. Periodic testing about once a month determines variations in surface-discharge voltage, losses and surface resistance. These tests are conducted to determine probable performance throughout the life of the equipment. This test line and field is considered of great value since natural conditions are encountered in a manner which cannot be accurately reproduced in the laboratory. Observations in the testing field are greatly facilitated by the installation of suitable instruments and measuring devices in the house shown in the views of the test field.



Pin-Type Insulators on Outdoor Testing Racks.



Suspension Insulators Showing Guard Rings at Each End of the Set.

STOCK OFFERING TO EMPLOYES OF GENERAL ELECTRIC CO.

The General Electric Co., Schenectady, N. Y., is offering to its employes the privilege of subscribing for one to ten shares of its capital stock at the price of $136 a share. There will be a credit amounting to $20 per share, against the subscription price, which will represent a net return substantially the same as that which would be enjoyed by anyone purchasing stock on an installment plan, paying interest on deferred installments and receiving cash and stock dividends. Payments are to be made by deductions from salary in monthly or weekly installments.

ENGINEERS HEAR PLANS OF SUPER-POWER COMMITTEE.

W. S. Murray, chairman of the super-power committee of the United States Geological Survey, will deliver an address before the Westinghouse Club, Wilkinsburg, Pa., on Thursday evening, Nov. 18. Mr. Murray will tell of the proposed super-power system which will connect the hydroelectric plants of New England and the South with tide water plants and large coal-burning central stations in the East.

Construction Features of Snow Mountain Dam

Methods Used in Building Gravity Concrete Dam for Impounding Storage Water for Eel River Hydroelectric Plant of the Snow Mountain Water & Power Co. in California

A gravity concrete dam 625 ft. long, with a base width of 130 ft. and a maximum height of 130 ft., is being constructed by the Snow Mountain Water & Power Co., San Francisco, which operates a 10,000-kw. hydroelectric plant on Eel river, 20 miles from Ukiah, Cal.

The structure will be located 13 miles above the power plant and will require 90,000 cu. yds. of concrete. The purpose of the dam is to create a basin for the storage of water, making an adequate supply for operating the power plant during the low-water period of the summer season. It is estimated that the proposed basin will store a maximum of 73,000 acre-feet.

Plans were prepared under direction of B. C. Condit, consulting engineer for the company, and the work is being done by W. A. Kraner, Inc., engineer and contractor, San Francisco. On this project the company will expend about $1,500,000.

The accompanying illustrations show the progress of the work as it appeared in May. In Fig. 1 is shown a part of the trestle structure and construction plant at the dam site, including bins and bunkers containing the crusher, elevator, screens, washers and concrete mixers. There also appears a partial view of an inclined railway track over which sand and gravel are hauled from the bed of the stream to the receiving bins.

A cofferdam of timber-pile construction was driven across the stream at a point 200 ft. above the dam, and a timber flume 4 by 12 ft. in cross-section and 350 ft. long was built. This flume begins at the upper face of the cofferdam and extends downstream, the purpose of which is to conduct the entire volume of water through the dam. It discharges at the lower end into a channel that was excavated in the bed of the river a distance of 1600 ft. Fig. 2 shows the operation of a Pawling & Harnischfeger excavator in mak-

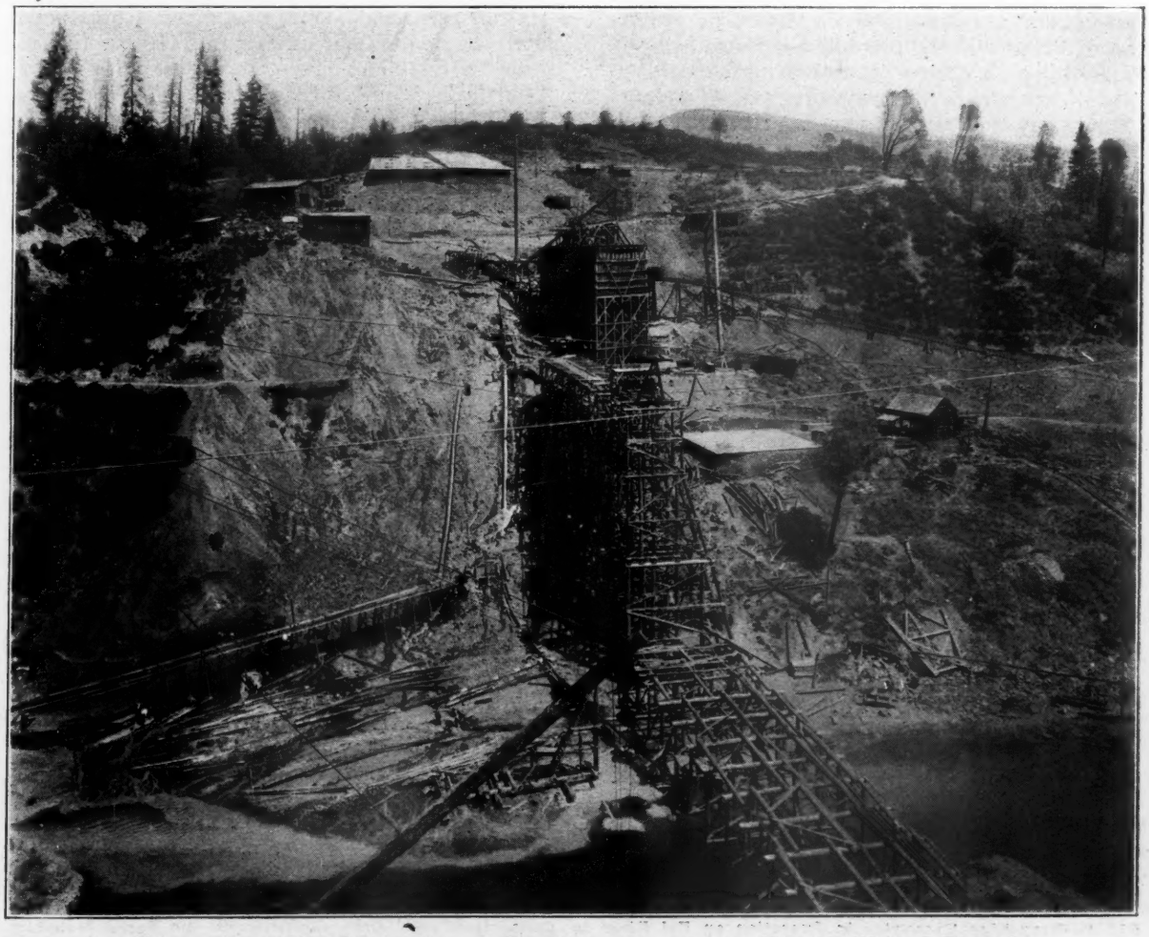


Fig. 1.—Dam Under Construction on Eel River, Cal., for Snow Mountain Water & Power Co.

ing this channel, which has a width of 18 ft. and a depth of 3 ft. below the normal bed of the stream. The object of this work was to lower the water level in the river and accelerate the flow after the water leaves the flume.

The sand and gravel for the concrete mixture is loaded by a steam shovel and drag-line excavator into dump cars of 5-cu. yd. capacity and hauled to the receiving bins over the inclined tracks having a 25% grade. This is a surface tramway on which the three cars used are run at a speed of 200 ft. per minute by a motor-operated hoist of 100 hp. At the upper end of the incline the carloads of material are dumped into bins, from which it passes through an automatic feeder to a rotary grizzly. The grizzly reject, which is 3.5 ins. and over, is reduced by a No. 5 Champion crusher. The grizzly fines and the crusher product, after being united, are then passed by chute into a bucket elevator that stands at an angle of 67.5 deg. and extends to a height of 75 ft. It carries 30 by 12 by 5-in. buckets on an 8-ply belt with a 0.125-in. rubber cover. The material is discharged by the elevator into a hopper at the top of the bunkers, and passes thence into two sets of two revolving screens, each 20 ft. long and 40-in. dia. Each set is divided into two sections, one having 3.5-in. holes and the other 1.75-in., the latter having a sand jacket of 5/16-in. mesh. Below the sand-jacketed screen is a sand washer, consisting of a double-screw conveyor, each 16 ins. in diameter and 15 ft. long. The washed sand passes by gravity to a bin for that grade of material. The material of various grades is passed by gravity through chutes to the mixers, the chutes being so devised that they serve as measuring hoppers.

Cement for the job is stored in sheds at a higher level than the mixing plant, and the sacks of cement are passed by gravity through chutes to sack-shaker house where sacks are opened. The bulk cement is thence carried by a 9-in. screw conveyor, operating inside a metal box 65 ft. long, to a hopper from which it is fed through two 10-in. pipes to the two 2-yd. Ransome mixers, in which a 1:3:6 mix is made. The mixer batches are passed into hoppers, from which the concrete is discharged into a train of four 2-yd. cars and delivered on a trestle-supported track along the upper face of the dam. Those cars discharge into hoppers on the trestle from which the concrete is distributed for dam construction through metal chutes. Solid footings for the concrete structure were reached at 16 to 25 ft. below the river bed.

Most of the equipment on the job, comprising winding hoist, crusher, grizzly, screens, elevators, conveyors, mixers and pumps, are motor operated. Concrete pouring was begun early in the summer, and the work is to be completed by Dec. 1.

HEAT LOSSES IN ELECTRIC STEEL FURNACES.

Data and Comments on Experimental and Practical Work and Development of Auxiliary Furnace Equipment.

By Frank Hodson,
President, Electric Furnace Construction Co.

A paper presented before the American Electrochemical Society in Cleveland by M. R. Wolfe and V. de Wysocki gave an analysis of the heat losses through the electrode of a three-electrode six-ton furnace. The figures given in this paper will, no doubt, surprise many electric-furnace users as to the amount and cost of power being lost through the furnace roof. After a close study of this particular problem for the last four years the writer is only surprised that the losses recorded were not larger. If the amount of heat

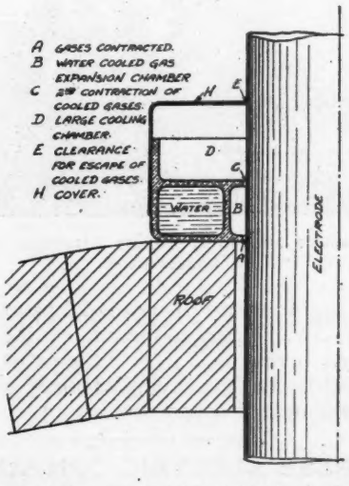
Fig. 2—Drag-Line Excavator in Operation on Eel River in Connection with Dam Construction for Snow Mountain Water & Power Co.

in the shape of flame that escapes from most furnace roofs were taken fully into account, the loss would be found to be nearer 30 than 18.7%. The method employed by the authors of the paper, while giving actual heat losses from the electrodes, only gives the heat absorbed by the water cooler. A great deal more than this is usually lost. In considering these heat losses, which perhaps would be better described as losses through the furnace roof rather than through the electrodes, it might be interesting to consider how the conditions governing the loss of heat and power can be improved.

Broadly speaking, the causes of this electrode heat loss are faulty electrode joint or defective electrodes, imperfect contact or badly designed electrode holders, pencilling off of the electrode at the point of arc and the combining of oxygen from the air with the carbon of the electrode and the resultant burning off of the electrode. Special care should always be taken in jointing up electrodes. Troubles due to defective jointing become increasingly worse as the melt proceeds. Electrodes of good quality can now be purchased and it is good economy to pay even a little higher price for electrodes of proven quality. Design of the electrode holder should be carefully considered and changed if undue losses occur. With proper contact little or no heating should occur at the holder contact. On some furnaces it has not been found necessary to install water-cooled holders.

Excess Air Causes Pencilling If Not Guarded Against.

Pencilling of electrodes is probably the indirect cause of more heat losses than any other feature. It is accentuated in cases where too large a space is left between the electrodes and the cooling ring, where the furnace doors are not kept prop-



Section View of Furnace Roof and Electrode Economizer.

erly closed at the bottom or where, as in some cases, the melter has to unduly open his doors to inspect or rabble the molten charge. Air strikes the white-hot electrode and burns away carbon; the hole in the roof acts as a flue and the electrode pencils off so that the area at the bottom where the arc is maintained is often only one-fifth of what the furnace builders have designed to carry the power supplied to the furnace. Current continues to flow through this restricted area of electrode, and the resistance to the excessive current over the smaller area results in the whole electrode being heated up by power that should go into the arc. This also causes trouble with the joints, the holders and on all the outside electrical connections.

With these facts in mind metallurgists have been working for the last five years in an effort

Three-Ton Greaves-Etchells Furnace in Plant of Dodge Steel Co. at Tacony, Pa.

to prevent this pencilling and heating of electrodes. It was realized early in the investigation that if the flame could be prevented from blazing out at the top pencilling would be largely overcome. Experiments have been made with over a dozen different types of water cooler, and also attempts were made to insert an inert gas under the furnace roof. As a result of these experiments F. W. Brooke, vice-president of the Electric Furnace Construction Co., has developed a type of electrode-cooling ring or "electrode economizer," now fitted as standard equipment on all Greaves-Etchells furnaces, that really does prevent this flame and the consequent pencilling of electrodes and other troubles caused thereby. These economizers have been fitted to a number of furnaces and have stood up remarkably well. Some have been in constant operation for six months and are as good now as the day they were installed. The invention is covered by patents, but can be supplied for all types of furnace. The Brooke economizer depends for its action on the well-known fact that hot gases under pressure, if suddenly allowed to expand, quickly lose their high temperature. The gases generated in an electric furnace are only combustible at high temperature and in the presence of oxygen. All other cooling rings simply cool these burning gases. In the Brooke economizer the gases never do ignite. The roof ports and electrodes are kept reasonably cool and the gases leaving the furnace are at too low a temperature to ignite.

The gases pass between the electrode and the roof port hole, then through the small clearance space marked *A* in the illustration into the cooling ring and into a relatively larger chamber *B*. This causes the expansion of the gases, resulting in their giving up a large amount of heat. This heat is absorbed by the water in the cooling ring.

From chamber *B* they are once more contracted through the small clearance *C* and then passed to a large chamber *D* for a second and chief expansion. The design differs slightly with amorphous or graphite-carbon electrodes, but the effect is that no flame is seen from the top of the furnace and the electrodes do not pencil off.

An accompanying illustration of a three-ton Greaves-Etchells furnace at the Dodge Steel Co., Tacony, Pa., shows the actual size of the cooling ring, and it may be noticed that although the electrodes are withdrawn and the furnace is pouring there is no flame or reduction of diameter. Even when carbon is thrown on the slag no flame appears. On a recently installed four-electrode furnace the monthly figures showed a consumption of only 12 lbs. of graphite electrodes per ton of steel. The average over a six months' period was 12.5 lbs. with a power input of 550 kw-hrs. per ton of steel. Tests are now being made on a furnace fitted with the special-type cooling ring, but it can be seen with the naked eye that the temperature of the electrodes is far less than common and, therefore, considerable saving of heat and power does take place.

ACCUMULATOR PRESSURE MAINTAINED BY ELECTRIC MOTORS.

Two Motors Regulate Pressure During Period of Heavy Duty and One Motor Carries the Load at Other Times.

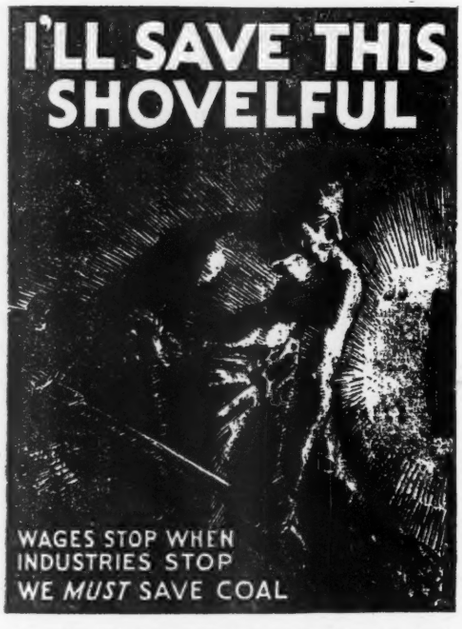
By the means of automatically controlled motor-driven pumps, hydraulic accumulators at a plant in the Middle West are kept at full pressure without any attention of the operator other than casual supervision. The control is so designed that it is an easy matter to arrange for the best operation. The two 58,000-lb. accumulators, each having a 12-in. plunger diameter and a 12-ft. stroke, can either operate together or separately. When the full operating pressure of 550 lbs. is attained the accumulators are at the top of their stroke. As the stored energy is used the plungers are lowered, and as they are lowered switches are closed which cause the motor-driven pumps to start.

The method of varying the operation of the control is exceedingly interesting. On a marble switchboard immediately outside of the pump room are installed the double-throw knife switches for the pumps. Each of the three 5-in. by 10-in. Worthington-Deane hydraulic pumps are driven by a 50-hp., 230-volt, 700-r.p.m. compound-wound Westinghouse motor. These motors are connected to the middle terminals of their respective switches so that they can be connected to the line through either of two sets of switches on the accumulators. For instance, with two motors operating the two accumulators, one motor will be connected through one set of switches and the other motor will be connected through the other set. Then as one accumulator is lowered by the use of the elevator, the motor whose switches are passed first will be started if the accumulator is lowered further, or if the other accumulator passes the second set of switches the second motor will be automatically placed in operation. The operation of these two pumps will cause the accumulators to rise, and as the first accumulator passes the cutout switches one of the motors will be stopped. But this is all that this one accumulator can do. It will probably pass the second switch, but this will not stop the other motor. The second motor cannot be disconnected until the second accumulator rises completely to the top. For this reason the accumulators are sure to be at the top of their travel and have the maximum energy stored when the motors stop.

The switchboard is so arranged that either motor can be connected through either set of switches. This allows a single motor to be operated separately if necessary. During light loads this is done, one motor being used one day and another the second day so that the maintenance on the three pumps will be somewhat equalized.

POSTERS CARRY "SAVE COAL" MESSAGE TO INDUSTRIAL PLANTS.

To further its "Save Coal" campaign, the Chicago Association of Commerce has had several thousand posters printed in red and black to display in engine rooms of industrial plants throughout the city. A reproduction of the poster is presented herewith. It is anticipated that this drive will lead to the saving of many tons of fuel within the next few months.



Effective Method of Calling Attention to Coal Conservation.

JAPANESE ELECTRIC COMPANIES TO CONSOLIDATE.

The decision on the part of three electric plants in Japan to amalgamate as a joint-stock company, capitalized at 100,000,000 yen (approximately $50,000,000) has been announced. It is further proposed that two other power companies be included in this consolidation, which amalgamation would be the complete merger of big power-supply companies in the western part of the main island of Japan.

EDITORIAL COMMENT

Selling Service

A cleverly worded story advertising the utiltiy of a line of ventilating blowers speaks of good ventilation as an invisible part of a business transaction in a department store. Truly, good ventilation does contribute much to the comfort of both employe and customer in a business house, but ventilation is only one item in the total invisible portion of every transaction. The sum total of all the invisible elements make up what is commonly termed service.

Service, or the invisible part of the transaction, is one of the major elements upon which the present success of the electrical industry has been built, and it is only by the maintenance of this service idea that the industry can continue in good favor and reach the fullest development. Service has its place in every branch of the industry and in every detail of each branch. The idea is worked out in one detail in examinations given to new operators coming into the organization of a large central-station company. Each one is required to say in response to an appropriate question, "I work for a public-service corporation," and he must say the words "public" and "service" with particular emphasis. Other details of the examination are arranged to impress upon the mind of the new operator the important fact that he must maintain the service every minute of his time on duty if it is humanly possible to do so.

With central-station companies making every effort to supply the customer with service, it is easier for the contractor or dealer to gain the good will of the public, and his customers in particular, by co-operating in the service idea. With the lines always alive and ready for use, the iron toaster or washing machine is also always ready to respond to the desires of its owner, provided it is in good condition itself.

The customer with his desire for one service well satisfied, by the laws of economies becomes a prospective customer for a new service. But if the original want was not fully and properly taken care of, and remains unsatisfied, it is only a source of trouble and discontent instead of serving as an introduction for a new and easy sale.

In other words, satisfaction creates new desires and new needs, and new needs create new business, with its opportunity for new satisfaction. The chain is continuous as long as it is not broken by failure to include the invisible portion with the customer's purchase of goods that are real and tangible. The customer may not see this invisible element and probably does not know what all it contains, but the contractor or the dealer knows what it is and knows how to deliver it with each sale if he is awake to the opportunities of his business. The logical procedure is to sell satisfaction, each one in his own field, and maintain the progress of the industry. If it is ventilation that is needed, or if a fuse needs attention, give the ventilation and renew the fuse, and let the reward come in the prosperity that is bound to follow satisfactory service.

N. E. L. A. Publicity Work

Ambitious plans for the popularization of the use of electricity were announced as part of a publicity campaign inaugurated a month or so ago by the National Electrical Light Association. These plans include a wide distribution by member central-station companies of a series of booklets giving simple but pertinent facts about electricity and its use. There is no doubt but what the public is uninformed and misinformed as to these matters. The booklets, which are constructive to a marked degree, will do much to allay the fears and suspicions with which the public views electricity and all that is connected with it.

Perhaps the mystery that has always been attached to electricity has been responsible, in a measure, for the attitude that the layman has assumed toward central-station companies. It is only natural to suppose that he should be suspicious, for, in many cases, his only dealings with the company are to receive monthly lighting bills stating that he owes so much money for so many kilowatt-hours, a unit quite unknown to him. Bills are not welcome missives, especially when all the terms in them except the amount of money are couched in unfamiliar terms.

It cannot be expected that the layman will go much out of his way to learn facts and figures about electricity, but no doubt the average consumer is enough interested to exhibit some concern if they are presented to him in an attractive and understandable manner. Wide circulation of the booklets, such as contemplated by the National Electric Light Association, will lessen the opportunity for misunderstandings and disprove many false impressions that have existed about the central-station industry and its service to the public.

THE WEEK'S NEWS

Reports of Important Meetings, Developments and Other Happenings of the Electrical Industry and Its Allied Interests

ELECTRICAL ENGINEERS WILL MEET NEXT WEEK.

Four Papers on Lightning Protection to Be Presented at Nov. 12 Meeting of American Institute in Chicago.

The American Institute of Electrical Engineers will hold its 365th meeting Nov. 12 in Chicago under the joint auspices of the Chicago Section and the Protective Devices Committee. The Electrical Section of the Western Society of Engineers will participate in the gathering. The technical session, at which four papers will be presented on the subject of "Lightning Protection," will be held at 7:30 p. m. at the City Club, 315 Plymouth court. This session will be preceded by an informal reception at 5:15 p. m. and an informal dinner, also at the club rooms, at 5:45 p. m. The rooms of the Western Society of Engineers, 1735 Monadnock block, have been designated as Institute headquarters, where the board of directors and various committees will hold their meetings during the afternoon.

The papers to be presented at the technical session are: "Lightning Arrester Spark Gaps—Part II," by C. T. Allcutt, Westinghouse Electric & Manufacturing Co.; "Life and Performance Tests of O-F Lightning Arresters," by N. A. Lougee, General Electric Co.; "Studies in Lightning Protection on 4000-Volt Circuits—Part II," by D. W. Roper, Commonwealth Edison Co., and "Electrostatic Condensers," by V. E. Goodwin, General Electric Co.

TO INVESTIGATE QUESTIONS ON INDUCTIVE INTERFERENCE.

Engineering Department of N. E. L. A. to Assist Members in Developing Rules Covering Power and Signal Circuits.

W. J. Canada, representing the engineering department of the National Electric Light Association, is on a trip through the western states investigating and discussing with representatives of member companies certain phases of inductive interference, overhead line strength and similar matters. He is also conferring with member company officials and engineers regarding current local problems and commission activities along these lines.

Several public service commissions are considering the adoption of rules governing inductive interference and it appeared essential that N. E. L. A. members be prepared to assist in securing rules as well balanced as possible in their requirements upon power circuits on one hand and upon signal circuits on the other hand. The development of such rules will require considerable study, since the only rules now available are those of the California Railroad Commission, which are largely limited to the consideration of detailed requirements on power circuits. In a recent North Dakota case, where the state commission was obligated by law to put into effect within a specified period rules governing inductive interference, the only practicable course was to use the California rules without change, in preference to adopting certain proposed modifications of these rules, which would have made them considerably more burdensome to power companies if adopted. Similar situations are arising with regard to safety rules, and the association considers it desirable to determine upon a uniform policy for dealing with such situations and upon generally satisfactory requirements which will not be unduly burdensome.

PUBLIC UTILITY SITUATION FROM INVESTORS' STANDPOINT.

National City Co. Gives Data on Electric Light and Power Companies—Recommends Utility Securities to Public as Good Investment.

At the recent convention of the Investment Bankers' Association of America, O. B. Wilcox, chairman of the Committee on Public Service Securities of the National Electric Light Association, presented some pertinent facts on utility conditions. As a result a resolution was adopted by the Investment Bankers' Association to the effect that there should be co-operation between the investment bankers and the owners and operators of utilities, regulating bodies, etc., in order that expansion may be made.

In line with that idea the National City Co. of New York City has seen fit to make the following statement in a recent bulletin:

> The passing era of high prices imposed severe hardships on public utilities. Their rates were generally determined by state, municipal or other regulatory authority, which, in many cases, did not promptly recognize the needs of the hour. The period was one of test and trial, and public utilities as a whole performed most creditably. Public service commissions and municipalities have in a large majority of cases now allowed increases in rates in conformity with advancing costs. Generally speaking, the position of most electric light and power companies is sound, and, in many instances, through strong, efficient management, is better than at any other time in their histories. Many of the gas and electric railway companies which suffered to a greater extent on account of the increasing tendency of labor and material prices, have recently been able to adjust their rates and are on the upward trend. The growth of our cities, the stable character of the business of public utility companies and public recognition of the necessity of increased rates, speak well for the future of these properties when soundly financed.
>
> In the light and power field the growth of our country and the new uses to which electricity is constantly being applied promise an attractive future for the public utility companies generating and contributing current. It is estimated that 14,000,000 homes in the United States have not as yet been supplied with electric light.

The builders await the earliest opportunity to catch up with the vast number of homes which must be built to offset the suspension in construction occasioned by war conditions. This, in itself, offers a great field for the development of the electric light business. Many homes also use power, and the application of electric energy to household appliances and to uses on the farm is a constantly growing feature of the business.

Power, generated in central stations and used in motor-driven machinery, is the twentieth century method of economical plant operation. Gradually, electricity has supplanted steam and other motive power, and today the great manufacturing concerns, and the thousands of factories occupying loft buildings depend upon it for motive power. Large central stations have demonstrated their ability to produce and distribute light and power at such an economical unit cost that their position is permanently assured. When such stations are of efficient type and particularly when operated by water power, the current is produced at a minimum cost and under most favorable conditions.

In a year marked by acute labor situations and serious delays in transportation, the electric light and power business has gone steadily forward. Reports show that during the first six months of 1920 this business increased 23%. Increased traffic, due largely to growth in population, and increased rates are steadiy improving the position of many of the traction companies. Fifty companies, reporting to the American Electric Railway Association, show an increase of about 20% in their passenger revenue for the first six months of 1920. Net earnings of these roads also increased 12%. There was an improvement in the number of passengers carried and rates have also been increased so that these companies are now receiving an average 7-cent fare, while in 1919 they received but 6.1 cents.

Discriminating investors are now analyzing the public utility situation. Such analysis should repay the investor through strong security and liberal return from well-selected public utility issues. New capital is required in every branch of the public utility field, and this company seeks to bring to the attention of investors securities which have been purchased after careful investigation and which, in our judgment, justify high confidence. Before the war public utility securities issued by corporations of undoubted strength and based on strong values and earning power were sold on a basis to yield around 5 to 5½%. Now, with largely increased values and increased demand for the output, the same class of securities can be bought on a basis to yield from 7 to 8%.

COMMITTEES ON UTILITY INFORMATION NOW AT WORK.

In connection with the appointment of various state committees on public utility information, mention of which was made in last week's issue of ELECTRICAL REVIEW, it is announced that a committee has been formed in Oklahoma and will be conducted under the auspices of the Oklahoma Utilities Association, with H. A. Lane, secretary of that association, as director. A committee is just being completed in Arkansas, with A. G. Whidden, Pine Bluff, as director. Committees are now actively at work in Illinois, Indiana, Kentucky, Nebraska, Ohio and Missouri.

TO GET CHAMBERS OF COMMERCE TO AID UTILITIES.

Copies of a set of resolutions calling attention to the fact that development of community life and prosperity of public utilities go hand in hand, that good service can be had only by payment of adequate rates, that increased costs have complicated the problems of utilities, and that the public should co-operate to the extent of being willing to pay fair rates for the service rendered have been sent by the Indiana Committee on Public Utility Information to each public utility within the state, with the suggestion that the executives of public utilities in each community which has a chamber of commerce take up with that organization the question of securing the adoption of the resolutions.

Copies of a similar resolution adopted by the Chamber of Commerce of the Borough of Queens, N. Y., have been forwarded by the National Electric Light Association to all member companies and to state committees on public utility information, with a suggestion that every effort be made throughout the country to have chambers of commerce take similar action. The desirability of making a national movement in this direction is being emphasized.

MUNICIPAL ELECTRICIANS MEET IN NEW ORLEANS.

Co-operation and Standardization Among Many Topics Discussed at Twenty-Fifth Convention of Association.

Subjects of interest to city electricians and police and fire-alarm superintendents were featured at the twenty-fifth annual convention of the International Association of Municipal Electricians, held in New Orleans, La., Oct. 19-22. The delegates were welcomed to the city by Mayor Martin Behrman, who hailed them as disciples of Edison, the response being made by C. E. Diehl, Harrisburg, Pa., former president of the association.

In his annual address President Robert J. Gaskill, Fort Wayne, Ind., referred to the spirit of unrest prevalent in many sections of the country, and came out strongly for the combating of radicalism in all its forms. He referred to the renewed activity in municipal electrical circles following the period of the war, stating that many cities are combining all their electrical affairs under the city electrician's direction.

William S. Boyd, Chicago, secretary of the Western Association of Electrical Inspectors, who spoke on the "Vital Importance of Voluntary Association," said there are times when everything is being subjected to a most searching analysis and that service is the keynote of success today. The days of inefficiency are numbered, the main essential of service is work, co-operation being the chief slogan of efficient service. The transcontinental wire-using corporations are alert to the advantages of establishing uniform requirements for pole-line construction throughout the country, Mr. Boyd declared in referring to matters electrical, which meant nation-wide co-operation. He was of the opinion that the association had not shown the vigorous growth it should and urged more co-operation on the part of the entire membership with that end in view. It is necessary to promote uniformity in the interpretation of the rules of the National Electrical Code and the rules for signaling systems, which means much for the safety and well-being of the public. In closing he said: "I am sure you feel that our association must endure and we pledge ourselves to the motto of 'work applied to service and made effective in co-operation.'"

A paper on "Rubber Insulation" was read by

Daniel J. Morgan, Hazard Manufacturing Co., following which there was discussion as to the relative merits of rubber and paper-covered cables.

"Fire Alarm Boxes vs. the Telephone as a Means for Calling Fire Departments" was the subject of a paper read by A. L. Duckett, Asheville, N. C., which gave the advantages of fire-alarm systems over telephone alarms. In the discussion that followed, C. F. Maulin, Gamewell Fire & Police Telegraph Co., referred to strikes of telephone employes and the fact that telephone exchanges are sometimes destroyed by fire. He also stated that fire-alarm telegraph systems are usually automatically operated and are seldom affected by external troubles.

There was considerable discussion, led by J. W. Kelly, Jr., Camden, N. J., on a revision of fire-alarm installation rules, following a report of the signaling committee with reference to auxiliary alarm systems. Mr. Kelly suggested the installation of special master boxes in large industrial plants and the discontinuance of the use of street boxes as master boxes. He favors an auxiliary system in all factories and large buildings. Robert Moran, Memphis, Tenn., spoke for the supervision of all auxiliary systems by fire-alarm superintendents, with a uniform set of rules from the National Board of Fire Underwriters to govern such systems.

A paper by Dr. E. B. Rosa, Bureau of Standards, Washington, D. C., on the "Scientific Work of the Federal Government," was read by W. L. Potts of Detroit. It dealt with the activities of the government along scientific lines during the war.

STANDARDIZATION COMMITTEE REPORTS PROGRESS.

The report of the standardization committee, presented by R. A. Smith, Norfolk, Va., was not made in full. Work is being done on Class D, which will contain recommendations for public lighting on thoroughfares, boulevards and "white ways," showing the prevailing practice.

C. K. Ahearn, Waterbury, Conn., read a paper on "Emergency Signaling in Connection with Fire Department Running Cards," in which he referred to the various kinds of signals used to attract the attention of patrolmen while on their beats, with special reference to the flashlight and horn and their uses in police departments.

A paper on "Joint Construction of Pole Lines" was read by H. B. Gear, distribution engineer of the Commonwealth Edison Co., Chicago. He stated that the joint use of poles has become a standard practice between telephone and electric companies in many cities where both maintain distribution plants. A detailed explanation of the advantages of joint construction of such lines was given.

A paper by F. H. Findley, switchboard sales engineer, Western Electric Co., on "Private Branch Telephone Exchanges in Connection with Police Signaling," was in the nature of a history of the rise of the telephone from its earliest days. Mr. Findley went into detail on the various uses to which telephones are put, with special reference to police-signaling systems.

A description of the municipal lighting plant in Fort Wayne, Ind., was given by George L. Smith of that city. E. E. Salisbury, police-signal engineer of the Gamewell Fire & Police Telegraph Co., read a paper on the "Installation and Care of Police-Signal Systems." Claude Convers, San Antonio, Tex., gave a demonstration of the proper method of pulling a fire-alarm box. J. Tyler Greene, Toledo, O., read a paper on "The Adequacy and Relative Economic Position of Municipal Fire Alarms," which was illustrated by a map of Toledo, on which was shown the location of fire and police-signal stations there, with special reference to the many fire hazards in existence in that city. Lyman E. Reed, New Orleans, presented a paper on "Panelboard Construction Relative to the Position of Switch and Fuse."

There was considerable discussion as to the advisability of giving superintendents of fire and police-signal systems entire authority over their systems. It developed that this was largely a matter of local conditions, as in many of the smaller cities the fire chief has charge of the fire-alarm telegraph. In the larger cities where the superintendent of fire alarm is a separate official, it was shown that in most of them the fire chief and fire alarm superintendent work in harmony. It developed that in some instances there had been some confusion with regard to the proper handling of signal systems, but the convention, generally speaking, favored giving the fire-alarm superintendent entire authority in his department, with the provision that he should work in harmony with fire-department officials.

The officers elected are as follows: President, R. C. Turner, Atlanta, Ga.; first vice-president, Dr. C. P. Steinmetz, Schenectady, N. Y.; second vice-president, William P. Briggs, New Bedford, Mass.; third vice-president, J. L. Caldwell, Colorado Springs, Colo.; fourth vice-president, D. R. Snider, Augusta, Ga.; secretary, Clarence R. George, Houston, Tex.; treasurer, William C. Crane, Erie, Pa. Executive committee, A. L. Duckett, Asheville, N. C., chairman; E. H. Benz, West New York, N. J.; G. P. Allen, Jacksonville, Fla.; William G. Dey, Louisville, Ky.; Claude Convers, San Antonio, Tex.; Charles K. Ahearn, Waterbury, Conn.; Walter Dilzell, New Orleans, La.; L. P. Sandiford, Savannah, Ga.; George L. Smith, Fort Wayne, Ind., and Frank K. Shinnen, Atlantic City, N. J.

It was decided to hold the 1921 convention at Colorado Springs, Colo.

TORONTO ELECTRICAL MEN HEAR ADDRESS ON CO-OPERATION.

Before a large and enthusiastic gathering of representative electrical men of Toronto, Canada, among whom were officials of the Ontario Hydro-Electric Co., Toronto Hydro-Electric Co., Toronto & Niagara Power Co., Canadian General Electric Co. and Bell Telephone Co., and jobbers, contractors and dealers, at a luncheon of the Toronto Electric Club on Oct. 29, James M. Wakeman, general manager of the Society for Electrical Development, spoke on "Co-operation Within the Industry." He talked of the results brought about by the activities of the society and other co-operative movements, particularly emphasizing the great success with which the elec-

trical pages are meeting throughout Canada and the United States, and stating that similar pages were beginning to appear in the newspapers of England and Scotland.

The necessity of keeping up the work of educating the public to an appreciation of electrical service and the importance of the public utilities were explained at length. The address brought forth expressions of enthusiasm despite the fact that the local conditions in Toronto are such that the power companies are unable to meet the demands made upon them for service and will continue to remain in this state until the Chippewa Falls development is completed next year.

STANDARD CONSTRUCTION OF RURAL TRANSMISSION LINES.

Realizing the immediate necessity for standard specifications in the construction of rural transmission lines, the overhead lines committee of the Technical Section, National Electric Light Association, has appointed a committee, with J. M. Drabelle, Iowa Railway & Light Co., Cedar Rapids, Ia., as chairman, to investigate conditions and report definite recommendations. The committee discussed the changed conditions regarding pole supply and agreed that steps should be taken to bring about a revision of pole specifications, which, it was pointed out, have not been revised since 1907. It was stated that since that time conditions have changed so that it is often necessary for companies to transport poles from great distances or to use lighter poles which in previous years would have been rejected.

SEND ELECTION RETURNS BY WIRELESS TELEPHONE.

An innovation in receiving and transmitting election returns by wireless telephone within a radius of 300 miles of Pittsburgh was inaugurated this year by the Westinghouse Electric & Manufacturing Co. and its subsidiary, the International Radio Telegraph Co. The returns were received direct from an authoritative source and sent broadcast by a wireless telephone stationed at East Pittsburgh, Pa. Receiving stations of almost any size or type were enabled to catch the messages within the radius by means of a crystal detector, a tuning coil, a pair of telephone receivers and a small aerial. By a two-stage amplifier the operator was able to attach his receivers to a phonograph so that messages could be heard anywhere in a medium-size room.

INTERNATIONAL GENERAL ELECTRIC CO. HOLDS CONFERENCE.

Representatives of Associated Companies from Various Countries of World Attend First General Meeting.

The first general conference of the International General Electric Co. was held at Briarcliff, N. Y., delegates from the company and associated organizations located in different countries throughout the world being present. President Gerard Swope presided at the meetings, a number of which were held during the week.

A dinner in honor of the representatives of the associated companies was given by the parent company at the Plaza Hotel, New York City, Friday evening, Oct. 29, at which 200 were present. President Swope, after expressing his appreciation of the attendance at the conference and the pronounced success of its deliberations, introduced C. A. Coffin, chairman of the board of directors of the General Electric Co., who presided during the speaking. Others who addressed the meeting were Ex-Secretary of Commerce William C. Redfield, Eugene Meyers, Jr.; Newcomb Carlton, president of the Western Union Telegraph Co., and J. W. Kirkland, Johannesburg, Africa. Officials of the General Electric Co. who were present included President E. W. Rice, Vice-Presidents J. R. Lovejoy, Owen D. Young and C. E. Patterson, Treasurer Henry W. Darling and others.

The delegates from foreign countries who attended the conference were:

Lt.-Col. Frederic Nicholls, president and general manager, and A. E. Dyment, vice-president and chairman of the board of directors, Canadian General Electric Co., Ltd.; M. T. McGovern, director general, Compania Electrica General de Cuba; M. V. V. Stewart,

Delegates of International General Electric Co. and Associated Companies at Dinner Given by Parent Company, Hotel Plaza, New York City, Oct. 29, at Which President Gerard Swope Was Chairman, and C. A. Coffin, Chairman of Board of Directors of General Electric Co., Was Toastmaster.

managing director, Mexican General Electric Co.; W. A. Reece, president, General Electric Sociedad Anonima, Argentina; President J. P. Grace, D. F. Iglehart, G. H. Coe, J. H. Torrens and J. W. Ellis, representing W. R. Grace & Co. in Bolivia, Chile, Ecuador and Peru; W. V. B. Van Dyck, president, General Electric Sociedade Anonyma, Brazil; Robert Wesselhoeft and F. H. Poor, Colombia and Venezuela; J. W. Kirkland, managing director, South African General Electric Co., Ltd.; Wilhelm Meyer and H. H. Arnold, representing Anderson, Meyer & Co., China; H. E. Page, managing director, China General Edison Co., Inc.; W. M. States, manager, Shanghai office, International General Electric Co., Inc.; H. E. White, Calcutta office, and R. C. Palmer, Bombay office, British Thomson-Houston Co., Ltd.; T. Isono, F. Ohashi and T. Nishioka, Shibaura Engineering Works, Japan; C. E. Randall, Y. Shimidzu and M. Nakamura, Tokyo Electric Co., Ltd.; A. W. Kendall, managing director, Australian General Electric Co.; E. W. Ackland, managing director, National Electrical & Engineering Co., New Zealand; Pierre Boty, administrateur-delegue, Societe d'Electricite et de Mecanique, Belgium; B. F. McMurtrie, manager of export department, and H. G. R. Rowe, contract department, British Thomson-Houston Co., Ltd.; W. C. Lusk, manager of London office, and H. A. Lingard, lamp sales division of London office, International General Electric Co., Inc.; Max Koch, director of commercial service, and Jean Canivet, resident engineer, Compagnie Francaise Thomson-Houston; E. A. Carolan, general European representative, International General Electric Co., Inc.; G. L. F. Philips, managing director, N. V. Philips Gloeilampenfabrieken, Holland; S. A. Trone, resident representative, Wseobshtchaia Electritcheskaia Kompania, Russia.

ELECTRICAL DEVICES TO BE SHOWN AT BOSTON EXPOSITION.

Arrangements are being made by electrical interests in Boston to hold a "Home Beautiful" exposition in that city April 16-30. Everything electrical, from the big range down to the tiny doorbell ringer, will be included in the many exhibits. It is announced that the floor space of the Mechanics building will be covered with hundreds of exhibits from makers of all kinds of devices used in the modern home. The main idea of the exposition is to teach efficiency to the general public and to show how much easier the housework can be done by the use of the electrical devices.

SOUTH BEND CHOSEN FOR INDIANA ASSOCIATION MEETING.

The Indiana State Electrical Contractors and Dealers' Association will hold its annual meeting in South Bend, Ind., Dec. 1-2. Addresses will be made by W. L. Goodwin, General Electric Co., and S. A. Chase, Westinghouse Electric & Manufacturing Co. Entertainment features of the convention will consist of a trip through the plant of the Studebaker Corp. and a visit to the University of Notre Dame.

RADIO ENGINEERS AND ELECTRICAL SOCIETY TO MEET.

A joint meeting of the Institute of Radio Engineers and the New York Electrical Society will be held Nov. 10 in the Engineering Societies building, 29 West 39th street, New York City. A paper on "Central Stations for Radio Communication" will be presented by E. F. W. Alexanderson, chief engineer of the Radio Corp. of America. The plans for the establishment of radio super-stations will be described and interesting material presented relative to the proposed expansion in the scope of radio communication. The Liebmann memorial prize for 1920 will be awarded at the meeting.

PUBLIC UTILITY COMPANY REACHES PEAK OF PRODUCTION.

The Binghamton (N. Y.) Light, Heat & Power Co. reached its peak of production during September, the output being the highest in the history of the plant, with aggregate generation of 2,186,620 kw-hrs. This is a 50% increase over the power output of the corresponding month in 1919 and a 9.5% increase in the production of the previous month of August, 1920. The company is making rapid progress in the installation of service lines at West Endicott, N. Y., for the housing developments of the Endicott-Johnson Co., manufacturer of shoes. It is anticipated that largely increased requirements in service demand will be evidenced within the next few months.

AMERICAN ELECTRICAL DEVICES ON DISPLAY IN BELGIUM.

American farm-lighting plants, washing machines, heating appliances, storage batteries and wiring devices are in big demand in Belgium. Apparatus of this type was the feature of the recent commercial exhibition held at Brussels Park. The Societe d'Electricitie et de Mecanique, the leading organization for development of the utilities of the country, selected the wares that were shown from among the products of the leading manufacturers of Europe and America. Among those who visited the exhibits from the United States were several leading European engineers and representatives of industrial and agricultural societies.

COMING CONVENTIONS.

National Association of Railway and Utilities Commissioners. Annual convention in the board room of the Interstate Commerce Commission, Washington, D. C., Nov. 9-12.

American Institute of Electrical Engineers. Meeting in Chicago Nov. 12 under auspices of the Protective Devices Committee. Secretary, F. L. Hutchinson, 33 West 39th street, New York City.

Electric Power Club. Fall meeting. Hot Springs, Va., Nov. 15-18. Headquarters, Homestead Hotel. Secretary, C. H. Roth, Adams and Loomis streets, Chicago.

Electrical Supply Jobbers Association. Semi-annual meeting, Cleveland, Nov. 17-19. Headquarters, Hotel Cleveland. Secretary, Franklin Overbagh, 411 South Clinton street, Chicago.

Southeastern Geographic Division of the National Electric Light Association. Annual convention, Miami, Fla., Nov. 16-19. Headquarters, Urmey Hotel. Secretary, Charles A. Collier, Atlanta, Ga.

Jovian Order. Annual convention, St. Louis, Nov. 25-26. Headquarters, American Hotel Annex.

Indiana State Electrical Contractors and Dealers' Association. Annual meeting, South Bend, Ind., Dec. 1-2. F. H. Shumaker, 902 South Michigan street, South Bend.

American Institute of Chemical Engineers. Winter meeting, New Orleans, La., Dec. 6-9. Headquarters, St. Charles Hotel. Secretary, John C. Olsen, Polytechnic Institute, Brooklyn, N. Y.

Illinois State Electric Association. Annual convention, Chicago, Dec. 9. Headquarters, Hotel La Salle. Secretary, R. V. Prather, Springfield, Ill.

COMMERCIAL PRACTICE

New-Business Methods, Policies, Rates and Kindred Central-Station Matters for the Man Engaged in Selling Electricity

GROWTH OF ELECTRIC INDUSTRY IN SOUTHERN CITY.

Louisville Gas & Electric Co. Issues Booklet Showing 82 Years' Record of Consistent Returns to Investor.

The investment department of the Louisville (Ky.) Gas & Electric Co. is sending out to its customers a booket bearing the title "Your Fortune," in which attention is called to the remarkable investment stability of the electric and gas industries of Louisville. The following paragraphs are quoted from the booklet:

"Think of your school-book history and the year 1838—somewhere about the time of Andrew Jackson and somewhat before the Mexican war. Louisville was quite a city then, big enough for a gas plant, so a gas business was founded and citizens lighted their homes and cooked their meals in a new-fashioned way. In 1882, Thomas A. Edison built the first steam-electric central station. It was in New York City, and Henry M. Byllesby, as a draftsman, prepared many of the plans. A few years later he installed the first lighting outfit in Louisville at the exposition.

"From 1838 to 1920 is a long stretch of time—an interval of 82 years, during which the United States has gone through four wars and many panics—a period wherein the nation grew from a little raw republic to the most powerful and wealthiest in the world. Every day since they were started, the gas and electric industries have been steadily at work in Louisville. Without them the city could not have grown. To build them up required the investment of large amounts of capital—more new money year by year as improvements and extensions had to be made to serve more and more people and industries. Now comes the point to be remembered, during this long period of 82 years neither the Louisville Gas & Electric Co. of Kentucky nor its predecessor companies have ever failed to meet the interest and principal of their bonds or failed to pay their preferred stock dividends, when preferred stock was outstanding."

AROUSING COMMUNITY INTEREST IN UTILITY SECURITIES.

Publicity Department, N. E. L. A., Issues Pamphlets on Electric Light and Power Industry for Security Holders and Others.

As a part of the general good-will campaign inaugurated recently by the National Electric Light Association, the publicity department of that organization, following conferences with the public service securities committee of the Investment Bankers' Association of America and the Public Relations Section executive committee of the National Electric Light Association, has compiled four pamphlets on the electric light and power industry, copies of which have been mailed to all members of both associations. These pamphlets are designed for distribution to public utility securities holders and to any others who may be particularly interested in the central-station industry.

The first pamphlet is addressed to "Mr. and Mrs. Citizen" and points out that the increasing use of electrical energy for lighting and power purposes necessitates a tremendous growth of the industry almost immediately. In order to develop the energy required to serve prospective consumers it is necessary that the utility companies be properly financed, and the present favorable market price of electric light and power securities is cited as an inducement to the person of limited means to invest in such securities.

The second pamphlet contains a message for "Mr. and Mrs. Securities Holder," and explains how and why every citizen of a community has an interest in the prosperity of the local electric light and power company and of the industry generally. As the owners of electric utilities securities they are urged to study the conditions surrounding the central-station industry, this

The Power of CO-OPERATION
WHERE the DOLLAR BRINGS RETURNS
The DEMAND WHICH Increases Dividends
The GREATER EARNING POWER OF PRESENT DAY INVESTMENTS

Covers on Four Pamphlets Distributed by Publicity Department, N. E. L. A., on Electric Light and Power Industry.

phase of the matter being touched upon in the third booklet of the series, which points out the soundness of the investment and makes the statement that "you can build no better for the future than by putting your money in this growing business you control."

The stability of and the service rendered by the electric light and power industry is brought out in the fourth pamphlet, which is addressed to "Mr. and Mrs. Citizen." The need for securing money for extending the service to the millions of people who desire it is emphasized. This money must be raised by the sale of securities, which presents an opportunity to invest in low-priced, fully secured, high-earning power securities.

On the back cover of each pamphlet, the following resolution, adopted Oct. 5 by the Investment Bankers' Association of America, is printed:

"Whereas, sound and constantly expanding public utilities are essential to the welfare and prosperity of the communities served;

"Whereas, the conditions resulting from the war have increased the costs of utility operation and of new money required for expansion, and prevented the growth of utility service to meet the increasing requirements of the public and of industry;

"Whereas, there is a recognized shortage of electrical power and it is of vital importance to the industries of the country that means be found for providing additional power supply;

"Therefore, be it resolved, that it is the sense of the board of governors of the Investment Bankers' Association of America that there should be co-operation between the investment bankers and the owners and operators of utilities and the regulating officials, in laying before the public full information respecting the vital importance of prompt and continuing expansion of all kinds of utility service, and in encouraging such utility regulation as will provide sound credit as the basis for financing, to the end that the investing public may provide the necessary funds by investment in sound public utility securities;

"Be it further resolved, that copies of this resolution be sent to the governors and the regulating authorities of the several states."

IMPORTANCE OF METER TESTING TO CENTRAL STATIONS.

Necessity for Periodical Meter Tests Pointed Out in Paper Presented Before Convention of Empire State Gas and Electric Association.

By F. J. Murmann,

Superintendent of Meters, Westchester Lighting Co., Mount Vernon, N. Y.

Electricity is bought by the consumer in much the same way that he buys food, coal or other commodities which are sold according to standard weights and measures. The difference lies only in the fact that electricity is invisible and must be measured by means which are not so clearly understood by the general public. In every well-governed community there is an official whose duty is to test the weights and measures by which general commodities are sold. If the weights and measures are correct there is no injustice done to the buyer or seller. Furthermore, the knowledge that means are being taken to provide accurate measurement instills confidence in the purchaser, which eventually benefits the merchant.

On account of the nature of electricity and the fact that each consumer must have an individual measuring device, it is natural that the operating company should act as official tester. Although the method of testing electric meters differs somewhat from that used in testing weights and measures for other commodities, nevertheless the fundamental reasons for testing remain the same. From an economic standpoint the question of periodical testing of consumers' meters is of vital importance to every electric company since the revenue depends upon meter registration.

Many of the larger companies realize the importance of testing consumers' meters and this work is now a part of the daily routine. There are, however, some companies that lay great stress upon the efficiency of other parts of the system and apparently overlook the inaccuracy of their meters. Progressive companies by periodical testing will do their utmost to see that meters retain their ability to register accurately. Meters operate under more varied and exacting conditions than most other pieces of apparatus, and being mechanical devices the natural tendency for them is to run slow. In spite of this fact they are expected to register accurately for long periods of time with little or no attention.

Companies Can Make Savings by Correcting Meters.

A company which has done little or no testing should be able to pay the expenses from the savings made by correction of slow meters. It is a matter of record that the accuracy of meters is more important from the standpoint of the company than it is from the standpoint of the consumer. Companies having thousands of meters in service for a number of years have found that approximately four times as many meters run slow as run fast. The consumer quite properly protects his interests by insisting upon having his meter tested when he suspects that he is paying for more than he receives. The company, having four times as much cause, surely ought to protect its interests by testing its meters.

Another reason for testing meters is one which rarely receives any consideration. There is no doubt of the fact that the continued periodical testing of meters by the companies has done more than any other one thing to stimulate the efforts of the manufacturers to place upon the market a meter which has reached the present standard of merit. If it were not for the fact that accuracy and reliability were the foremost requirements, meters might be sold on a purely commercial basis with the result that the present standard would be lower.

Aside from the previously mentioned reasons, there is another one. This is its effect upon the mental attitude of the consumer. It has been pointed out that devices used for measuring electricity are not clearly understood by the general public. It is natural for the public to mistrust that which is not clearly understood. It therefore follows that the operation and accuracy of electric meters is looked upon with suspicion. The periodical testing of meters will do much to maintain the confidence of the consumer and will frequently prevent unjustified complaints in connection with bills.

OPERATING PRACTICE

Methods and Problems Embracing Operation and Installation of Power-Plant Equipment and the Distribution of Electrical Energy

AUTOMATIC STOKERS ELIMINATE SMOKE FROM HOTEL PLANT.

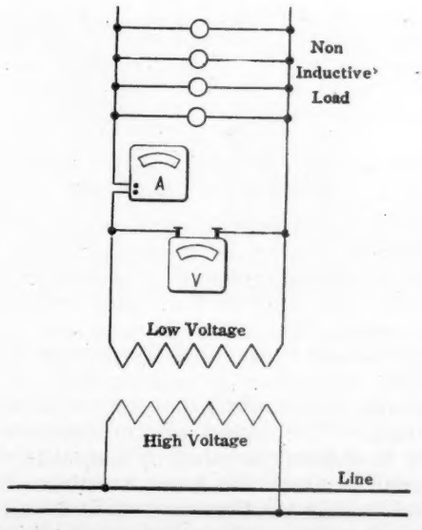
Following a considerable period of controversy with the municipal authorities, the McLure hotel in Wheeling, W. Va., installed a set of Jones stokers to reduce the smoke given off from the boiler plant. Smoke reduction was accomplished and, in fact, according to statements made in a local paper, smoking of the stack was entirely eliminated excepting for short intervals when firing conditions were being altered.

In addition to eliminating the smoke difficulty, the stokers have effected a saving of approximately 25% in the coal consumed, have eliminated much of the ash troubles besides reducing the amount of ash produced, and have generally improved operating conditions and reduced operating labor. The hotel management is more than pleased with the change from hand firing to automatic stokers.

NON-INDUCTIVE AND OPPOSITION TESTING OF TRANSFORMERS.

Temperature Rise Limits Capacity of Transformer and Other Kinds of Electrical Equipment.

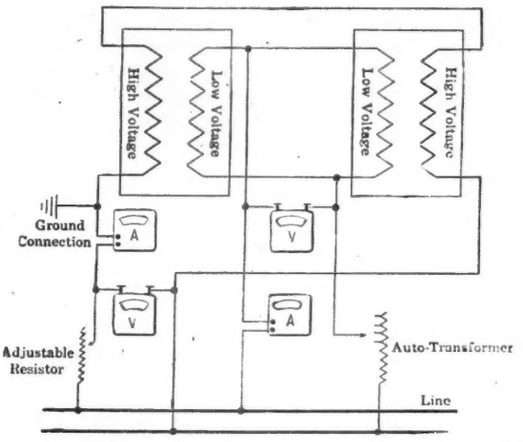
The actual load which may be carried by any piece of apparatus depends entirely upon the temperature rise under such load. A transformer which is to be loaded only three hours a day may carry a larger load than if it must operate continuously. It is, therefore, important that the temperature rise be determined, especially when operating conditions are abnormal. The tests described below are those recommended by the Wagner Electric Manufacturing Co., St. Louis,



Transformer Being Tested With Non-Inductive Load.

as being suitable for large and small transformers.

When only a single unit of a given size is available a temperature test may be made with a non-inductive load as shown in the accompanying



Circuits for Temperature Test of Transformers Connected in Opposition.

illustration, the current being adjusted to full-load value by means of a bank of lamps or other suitable resistance units. The transformer should be allowed to run at this load for the desired interval of time, temperature readings being taken of the oil in its hottest part and also of the surrounding air.

When it is desired to know the temperature of the coil rather than that of the oil, it is necessary to calculate the temperature by means of the resistance method. The resistance in both the high and low-voltage windings is measured at the beginning of the test and before any load has been applied. These readings are repeated at the end of the heat test, and the temperature rise can be calculated as described in the standardization rules of the American Institute of Electrical Engineers.

In making resistance measurements of large transformers, care should be taken to allow both the ammeter and voltmeter indications to settle down to steady values before the readings are taken. This may require several minutes, and each time the current is changed it is necessary to wait until the current has settled to its permanent value. All resistance measurement must be taken with great care as small errors in the resistance measurement may make very large errors in the determination of the temperature rise.

Testing Large Transformers Connected in Opposition.

The non-inductive-load test is satisfactory for small units, but when large units are to be tested the cost of energy for testing becomes an important item. The opposition test is an economical

one for large units and employs two transformers of the same size and ratio. In this test normal voltage is applied to the low-voltage windings, the voltage being adjusted by means of rheostats or auxiliary autotransformers. The high-voltage windings are connected so that the voltage of one winding opposes that of the other, and a voltage equal to twice the impedance voltage of either transformer is inserted in the high-voltage circuit. It should be remembered that when the low-voltage windings are fully excited there is full voltage across the high-voltage windings although the resultant circuit voltage is zero, and precautions must be taken to avoid short-circuiting either secondary or making contact across the terminals with the hands or other parts of the body. The application of the full impedence voltage in the high-tension circuit will establish full-load current in both the high and low-voltage windings, and normal voltage applied to the low-voltage windings will produce full-load copper losses.

Application of full voltage to the low-voltage windings will result in normal iron loss, and thus the two transformers will be subjected to normal operating conditions without taking their rated capacity from the source of supply. In fact, only power enough is taken from the lines to make up the total losses in the two transformers themselves.

Method of Computing Transformer Efficiency From Input and Losses.

The input of a transformer is equal to the output plus the losses inside the transformer itself. These losses are made up of the core loss, which is constant for constant voltage under all load conditions, and of the copper losses which vary with the current or load. The efficiency of a 5-kw. transformer with a 50-watt core loss and copper losses of 25 watts at half load and 100 watts at full load would be computed as follows:

For full-load conditions,

Efficiency = 5000/5000 + 50 + 100 = 97.1%.

For half-load conditions,

Efficiency = 2500/2500 + 50 + 25 = 97.1%.

RELATIONS OF THERMAL EFFICIENCY AND POWER-PLANT DESIGN.

Limits of Size and Economy Discussed in Paper Before Municipal Electrical Association at Bradford, England.

By I. V. Robinson.

The upper steam-temperature limit has been gradually raised by improvements in boiler, piping and turbine design to 650 or 700 deg. F. with a comparatively wide range of pressure obtained by varying the amount of superheat. Increase of pressure with a constant maximum temperature, obtained by reducing the superheat, is advocated as giving a greater heat drop. This also results in greater steam density and therefore allows smaller piping and fittings. Pressures of 500 lbs. per sq. in. with temperatures as high as 700 deg. F. are predicted for the near future. The lower or exhaust temperature is limited by considerations of the expense of maintaining high vacuums.

Saving low-grade heat has been attempted by heating the condensate to higher temperatures, using steam tapped from the main turbine, and by reheating the steam after partial expansion until the initial superheat is restored. Assuming that 10% of the turbine steam is withdrawn at suitable points, the condensate temperature might be raised by 100 deg. F. with a saving of about 1000 b.t.u. per pound of tapped steam. With 23% of the steam tapped out the condensate temperature rise might be as much as 225 deg. F. The effect is a slight improvement in spite of the loss of efficiency in the low-pressure stages of the turbines. Saving of heat by reheating the partially expanded steam has been tried experimentally, but does not seem to offer much chance for commercial success.

Turbine Sizes Limited by Transportation and Mechanical Details.

The size of turbine discs is limited by transportation as well as mechanical difficulties, an examination of thermal and financial considerations indicating that about 30,000-kw. is the maximum desirable capacity for a single unit with plants of 180,000-kw. load and 240,000-kw. installed capacity. Electrically driven auxiliaries, with a separate turbine-driven generator exhausting into a surface condenser, is thermally the most efficient of the various schemes of auxiliary operation. Other methods give good results and are sometimes advisable because of existing circumstances.

The material of which turbine blades are made is an item in maintaining the efficiency of the machine against loss due to wear and corrosion. For moderate steam velocities and stresses standard bronze is satisfactory, while 3% nickel steel is successful at higher velocities and stresses. In condenser-air-pump calculations it is customary to credit steam-ejector pumps with all the heat in the discharged steam which may be returned to the boiler in the feed water. However, it is shown that the usual boiler losses are involved in the raising of any steam and, therefore, all the heat is not reclaimed by condensing the steam from the jets. It is suggested that a Willans line be drawn for the overall fuel consumption of the various units of the plant so that steam requirements may be predicted for various conditions. Discussions of the Willans line, and descriptions of its construction and use, were given in the May 1 and 15, 1920, issues of Electrical Review.

CONCESSON GIVEN FOR ELECTRIC TRAMWAY IN PERU.

The Peruvian government has granted a 60-year concession for the construction and operation of a standard-gauge electric tramway which will run from Lima to La Punta, a distance of seven miles. The cars to be used will be of the storage-battery type. It is stated that the new company will have a capitalization of about $1,000,000, all of which has been subscribed by Peruvians. The names of the concessionaires, which have been furnished by Consul Roth, may be obtained from the Latin-American Division of the Bureau of Foreign and Domestic Commerce.

CONTRACTING-CONSTRUCTION

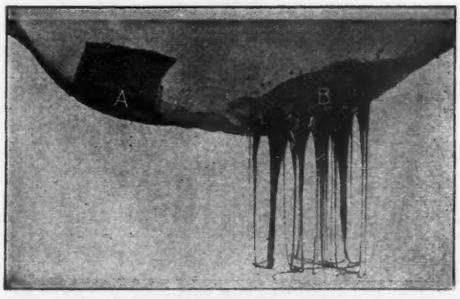
A Department Devoted to Various Problems Relating to the Installation, Operation and Maintenance of Electrical Equipment

IMPORTANCE OF FILLING COMPOUND IN CABLE JOINTS.

Fluidity and Other Characteristics Determine Services for Which Various Compounds Are Best Suited.

In the average there is about one joint for every 300 ft of lead-covered underground cable in the various distribution systems throughout the United States. These joints, if not properly made, prove to be the weak links in the transmission or distribution system on which they are installed. As a guide to the making of better joints, and so eliminating the weaker links of the system, the Standard Underground Cable Co., Pittsburgh, Pa., has prepared a number of rules and given out valuable suggestions based on actual experience in the construction and maintenance of underground joints. The following points relative to filling compounds have been extracted from these rules and suggestions:

Insulating compounds are used for filling cable joints, cable terminals and junction boxes thus excluding and replacing air and moisture which would induce discharges and eventual breakdowns between conductors and between conductors and the ground. Experience in the practical work of jointing, and constant experimentation to improve the qualities of insulating compounds, has shown that no compound can be made that will be equally well suited for all classes of service. Breakdowns are frequently caused by using good compounds that are not adapted to existing operating conditions, as well as by using inferior compounds. The characteristics which experience has taught a good insulating compound should possess are as follows: A good compound must attain great fluidity at a



Results of Two-Hour Test of Two Insulating Compounds Suspended in Screen at 125 deg. F.

moderate temperature in order that it may be put in proper condition for pouring by the use of an ordinary gasoline or kerosene furnace. It should not be so fluid as to run back into the abutting cable ends to any considerable extent at 135 to 150 deg. F., at which temperature power cable systems are operated for a considerable portion of the day. It should be free from brittleness even when more or less solid, possessing rather the elastic qualities of rubber in as high a degree as possible. This characteristic should be retained

Illustration Showing Action of Compounds in Opened Joints.

Joints *A* and *D* were filled with one compound and *C* and *D* with another. Joints *A* and *B* were exposed to temperature of 110 deg. F. for two hours. Joints *C* and *D* were exposed to temperature of 80 to 85 deg. for six weeks.

at temperatures as low as 25 to 35 deg. F., as otherwise in winter weather, when repairs are being made in cold manholes, serious damage will be done to the joints by thoughtless workmen using the cable joints as ladders, or by striking them with hammers, ladders or other implements employed in subway work. A slight bending strain on a joint of this sort or a sharp blow will, when the compound is very brittle, almost invariably result in the formation of thin thread-like cracks running from the inside of the lead sheath to the insulated conductor. These cracks form an easy passage for water in case, through faulty joints, it enters before the compound has been sufficiently heated to run together again. They also afford a vent through which, especially in high-voltage cables, electrical discharges will take place resulting in the ionization of the solid insulating material and an ultimate breakdown of the joint itself.

Electrical Properties of Compound Have Influence on Utility.

A good compound should have a fair measure of specific-insulation resistance, although it need not be unnecessarily high. It should have a high specific-voltage resistance, and should have a comparatively low electrostatic capacity. It should have a low dielectric hystersis, or what is sometimes termed "power-factor" of the insulation, and should be capable of adhering strongly to metal parts such as lead, brass, iron, etc., and to such solid insulating material as paper, rubber, varnished cambric, fibre, slate and porcelain.

In connection with this matter of desirable characteristics for compounds, it may be well to refer to a specific instance of improper use of a given compound for a definite purpose. A quotation from a letter written by a user of such a

compound is perhaps the most convincing form of statement. It is as follows: "We have experienced much trouble in using paraffine as its coefficient of expansion is so great that it is very troublesome, and also its melting point is so low that it runs down into the insulation of the cable in the heat of summer weather. In cases where we have used it with lead terminal heads it produces a vacuum inside the head and collapses the lead against the insulation of the conductors." A high coefficient of expansion is indeed somewhat objectionable, but a moderate one must be

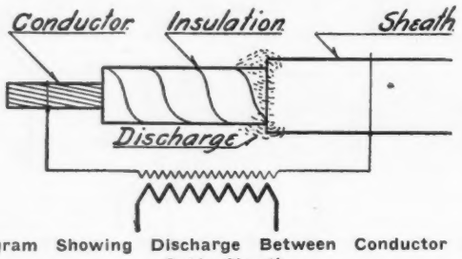


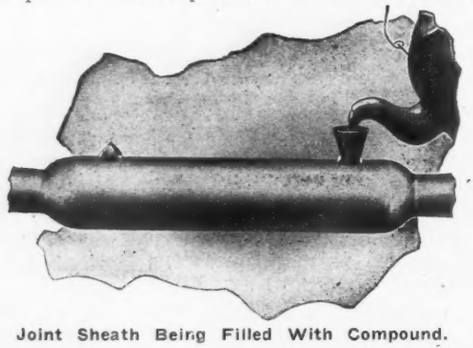
Diagram Showing Discharge Between Conductor and Cable Sheath.

accepted as unavoidable if the other desirable characteristics of a good insulating compound are obtained in anything like a satisfactory degree.

The necessity for having compound which will keep its place in the joint can not be over-emphasized. In many manholes the joints are somewhat higher than the other part of the cable, and, where compounds of too light a base are used, there is almost always danger of the compound slowly moving away from the joint into the abutting cable end at the lower side, it being a peculiar characteristic of some compounds to flow at any temperature. In such joints, even when they appear very hard and brittle, the compound will be capable of flowing out of extremely small openings, the rate of flow being dependent upon the pressure and temperature. This is well shown in the accompanying illustrations where one compound may be seen flowing even though it is hard and brittle, while the other compound retains its elasticity to a degree and shows almost no sign of movement.

Ozone Produced Where Cracks Are Made in Compound.

There is an additional reason, however, particularly in high-voltage cable, why the joint must be kept full of compound. When various volt-



Joint Sheath Being Filled With Compound.

ages are applied (starting with 1500 volts) between the conductor and sheath of an ordinary joint there will appear, when the experiment is made in a sufficiently dark room, an electrical discharge accompanied by a glow of light where the metallic sheathing comes in contact with the cable insulation. This electrical discharge is of the corona or brush type, and with it there is given off considerable quantities of ozone, dependent in amount upon the thickness of insulation which separates the conductor and the sheath, upon the voltage applied and other factors. This ozone is being produced in a manner similar to that which has been adopted for use in sterilizing water by oxidation of its vegetable and animal impurities. Its effect upon vegetable insulating material such as paper, fibre, varnished cambric, rubber, etc., is very deleterious and ultimate destruction of the insulation almost invariably ensues where it is exposed to the action of newly produced or nascent ozone for any considerable time. So long as the edge of the sheath and the neighboring wall of cable insulation are thoroughly covered by insulating compound so that air is excluded there will be little or no deterioration of the insulation at that point. The importance of keeping the joints and terminals on high-voltage cables thoroughly filled with suitable compound is self-evident.

MAKING PIPE BUSHINGS OF PIECES OF STANDARD PIPE.

Sizes of Pipe, Drills and Reamers to Be Used When Regular Bushings Are Not Readily Obtainable.

By W. F. Schaphorst.

Many pipe fitters do not know that bushings can be made from standard pipe, or, if they do know it, they do not know the correct size of drill to use for tapping in each case. Since it has been difficult, recently, to get bushings or other fittings in the stores, it is believed that information on this subject will prove of value to the contractor and the workman. The accompanying data covers all sizes of bushings that can be made from the ordinary sizes of extra-heavy and double-extra-heavy piping.

TABLE SHOWING SIZE OF PIPE AND DRILLS TO USE IN MAKING BUSHINGS OF VARIOUS DIMENSIONS.

To Bush From	Use This Size of Pipe.	Use This Size Drill or Reamer.
¼-in. to ⅛-in.....	¼-in.*	21/64-in. (0.328)
⅜-in. to ¼-in.....	⅜-in.*	None
½-in. to ⅛-in.....	½-in.†	2 1/64-in. (0.328)
½-in. to ¼-in.....	½-in.†	27/64-in. (0.422)
½-in. to ⅜-in.....	½-in.†	9/16-in. (0.562)
½-in. to ⅜-in.....	½-in.*	9/16-in. (0.562)
¾-in. to ⅜-in.....	¾-in.†	9/16-in. (0.562)
¾-in. to ½-in.....	¾-in.†	11/16-in. (0.688)
1 -in. to ¾-in.....	1 -in.†	29/32-in. (0.907)
1¼-in. to 1 -in.....	1¼-in.†	1 ⅛-in. (1.125)
1½-in. to 1 -in.....	1½-in.†	1 ⅛-in. (1.125)
1½-in. to 1¼-in.....	1½-in.†	1 15/32-in. (1.468)
2 -in. to 1½-in.....	2 -in.†	1 23/32-in. (1.720)
2½-in. to 2 -in.....	2½-in.†	2 3/16-in. (3.187)
3 -in. to 2½-in.....	3 -in.†	2 9/16-in. (2.562)
3½-in. to 3 -in.....	3½-in.†	3 3/16-in. (3.187)
4 -in. to 3½-in.....	4 -in.†	3 11/16-in. (3.688)
4½-in. to 4 -in.....	4½-in.†	4 3/16-in. (4.167)

* Extra heavy. † Double extra heavy.

To bush from a ¼-in. to a ⅛-in. pipe, a piece of ¼-in. extra-heavy pipe must be used. The pipe is threaded, drilled out with a 0.328-in. drill (21/64 in.), tapped with a ⅛-in. tap and cut to the proper length. Other sizes are made in the same manner, using the pipe, drills, etc., as indicated in the table.

NEW APPLIANCES

Newly Developed and Improved Electrical and Mechanical Apparatus, Appliances, and Devices Now Being Placed on the Market

Device for Changing Insulators on High-Voltage Lines.

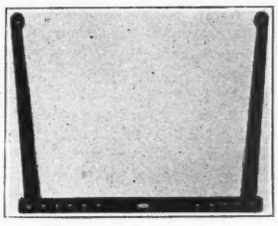
The Bush Electric Co., 6654 Broadway, Cleveland, have announced the production of a device for changing dead-end disc insulators on high-voltage transmission lines. The manufacturer states that this tool was designed primarily for use in connection with the "Safety Staging," recently mentioned in this column, for changing insulators on live lines. It is equally well adapted for work on dead lines, however, and possesses many advantages over the present method involving the use of a come-along and blocks.

The strain device consists of three beams made entirely of hard wood, which has been specially treated to withstand 100,000 volts for each 9 ins. of length. The vertical legs, *A*, are each made in two parts bolted firmly together at the lower end, but spread apart sufficiently by means of space blocks to accommodate the main beam, *B*, at the upper end. Holes are bored at intervals in the main beam in order that the horizontal distance between the legs may be adjusted to correspond with the length of the insulator string, the connections being made by means of loose-fitting steel dowel pins. A steel plate, *C*, containing a V-notch is fastened on the inside of each leg for the purpose of holding the wire just beyond the strain clamp.

The use of this device is clearly shown in the larger illustration. One leg is dropped down behind the cross arm. The other leg is detached from the main beam and then replaced with the wire passing through the notch as described above. By tightening the hand line at the lower ends of the legs the strain is removed from the insulators allowing them to sag. The hand line is then secured and the insulators removed. An extra main beam is supplied with each outfit, and the two main beams may be bolted together in order to secure greater length in removing an extra long string of insulators, or for removing two strings on opposite sides of the arm at the same time. The photograph shows linemen changing a string of strain insulators on a 33,000-volt line while working from a Bush safety staging.

Among the numerous advantages claimed for this device are the following: The main beam is well above the insulators and, unlike a rope used for this purpose, does not bind on the discs when the wire is pulled up. The great leverage obtained by the arrangement of the legs allows even the longest spans to be pulled up with little effort. The wood parts are all treated so that they cannot absorb moisture. This means that if a rain should commence after the insulators have been removed while working a line circuit, but before the replacement has been made, the men can leave the job as it is knowing that if a flash over to a grounded arm occurs the arc will dry the surface of the beam and break itself. The wood will not burn as a rope would under these conditions. This device can also be used to good advantage in changing suspension insulators on either a live or dead line.

Strain Device Being Used While Changing Insulators.

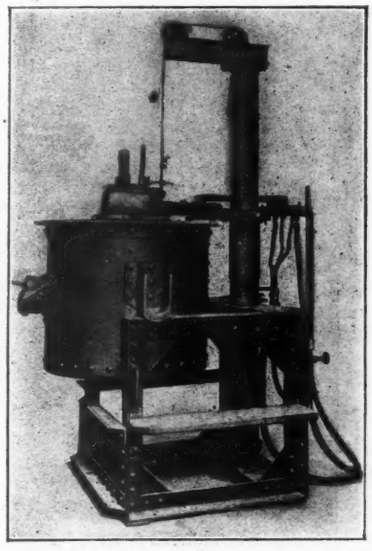


Strain Device for Holding High-Tension Wires.

Von Schlegell Repelling-Arc Electric Furnaces.

This type of melting and refining furnace, built by the Industrial Electric Furnace Co., Chicago, operates directly on 220-volt circuits without transformers. The arcs are drawn, sustained and regulated by a balancing system that automatically gives inherent stability. It is built in sizes from 300 to 3,000 lbs. per heat. Being suitable for melting and refining ferreous and non-ferreous metals, any metals that can be worked in a cupola, open hearth, air furnace, crucible or other electric furnace can be treated in this furnace.

In the smaller sizes it can be used to replace oil furnaces in brass foundries, and is suitable for special tool-steel work or for making small castings, melting alloy for larger furnaces, making metal patterns and for emergency or development work in large steel and gray-iron foundries.



Furnace With Electrodes in Place for Melting.

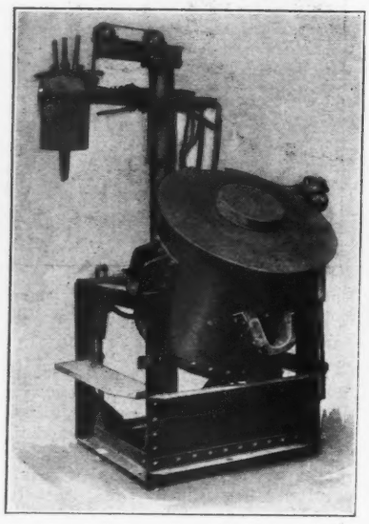
On account of its versatility it is superior in many ways to the cupola generally used in college foundries.

The furnace consists in general of a refractory-lined shell or furnace body through the roof of which is suspended a heating element which can best be described as an electric-arc torch. This torch diffuses a large and intensely hot flame inside the furnace body. The shell is cylindrical in shape and is made of extra-heavy steel plate. This shell is mounted on a portable steel frame which makes special concrete foundations unnecessary. A heavy rocker trunnion is mounted on each side and supports the shell on the frame, allowing it to lock after pouring. The furnace is tilted by hand, all mechanical tilting equipment having been eliminated in this design. One illustration shows the furnace in pouring position. When desired the furnace shell containing the molten metal can be lifted from the frame by a crane and conveyed to molds where pouring can be done direct from the furnace without the use of a ladle.

This furnace is built in single-phase, three-phase and d-c. types. Two electrodes are used with single-phase or direct current, while with three-phase three electrodes are employed. These electrodes are held in place by a refractory sleeve which is so mounted that the sleeve and electrodes can be raised out of or lowered into the furnace, or can be swung aside to permit charging through the opening in the top of the furnace. After

the furnace has been charged the electrodes and sleeve can be swung back to the center of the furnace and lowered to within a few inches of the charge. Then the power is applied and the arc put in operation. The arrangement for raising and lowering the electrodes makes possible a double furnace system by which two furnace shells are used with only one set of electrical equipment. The two shells are placed close together so that the same set of electrodes can be raised from one shell and put into the other. With this arrangement one shell can be melting at all times while the other is pouring and being recharged. The metal recharged in this way can be preheated by the heat in the furnace, or it can be preheated by gas or oil fire before the electrodes are swung over from the other shell. This duplex operation increases capacity, reduces floor space and tends to cut the cost of melting.

The furnace is lined with an insulating lining next to the shell. A ganister lining, mixed with fire clay and

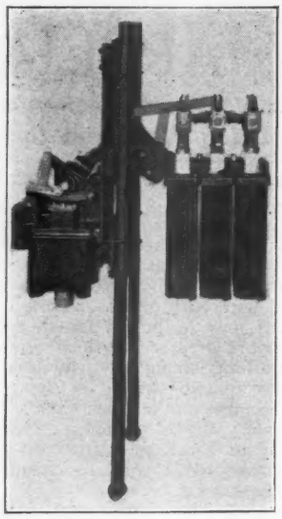


Von Schlegell Electric Furnace in Pouring Position.

glutrin, is next rammed in place with air rammers, making an inexpensive lining. If desired, of course, carborundum sand can be used instead of ganister. For basic operations a lining of magnesite and dolomite, with a small amount of basic slag and nonanhydrous tar for a binder, is used. The roof is made of fire-clay brick, using only 18 brick of the standard size always carried in stock.

Oil Circuit-Breakers of Medium Capacity.

Two new types of circuit-breakers, known as types FK-35 and FK-35-Y, made by the General Electric Co., Schenectady, N. Y., and intended for use on systems having voltages up to 7500, include several improvements in design and construction. The units are so constructed that single, double, triple or four-pole breakers can be made up by combining the required number of units, one for each pole, plus frame, breaker mechanism and operating mechanism. Each standard unit consists of an oil tank, cover, insulator studs, contacts, blades and rods. The fixed contacts,

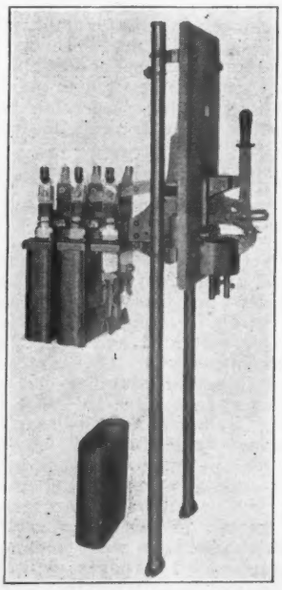


Single-Throw, 7500-Volt, Triple-Pole, Type FK-35 Circuit Breaker.

which provide two breaks per hole, consist of drop-forged copper fingers secured to a block at the lower end of the contact stud and are flared at the lower end. Supporting and reinforcing springs insure a heavy contact pressure. The movable contact blades are wedge shaped so as to confine the arc to the top of the blade, thus protecting the actual contact surface from pitting. Furthermore, since the blades close with a wiping motion, they help to keep the contact surfaces clean.

Operation is by gravity assisted by compression springs on the operating rods, there being one spring to each pole. These springs, being under compression when the breaker is closed, tend to increase greatly the speed of opening when the breaker is released. The breakers are operated either manually or by a solenoid. Manually operated breakers trip free of the handle, the position of the operating links on the front of the board indicating whether the breaker is open or closed.

All operating levers for manually



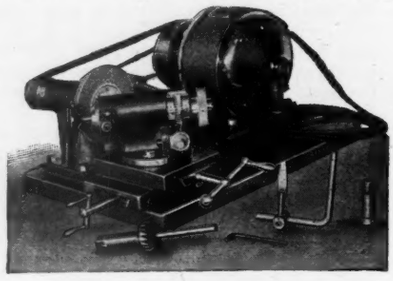
Single-Throw, 600-Volt, Triple-Pole, Type FK-35-Y Circuit Breaker.

operated breakers are the same, the nonautomatic lever being made automatic by simply adding the coils and the calibrating tubes. Calibration of the trip coils is done from the front of the panel.

Electrically Driven Automatic Valve Grinder.

An electrically driven valve grinder, with attachment for grinding a reseating tool, has recently been introduced to the automobile trade by the Franklin Machine Tool Co., Springfield, O. There are three units to the machine, the 0.25-hp. Westinghouse driving motor, the grindstone and the valve, which also has an attachment for holding the reseating tool. Both the grindstone and valve holder are connected by belt drives to the motor, the latter having its speed reduced through a worm gear so that the valve lip and the stone turn against each other. The valve holder may be set at any angle to the stone in order that the valve may get the proper set.

The reseating tool may be ground at exactly the same angle as the valve in order to make a quick and gasoline-tight fit. This tool is attached and operated through a flexible driving shaft, allowing the cylinder to be reseated without taking it from its position in the engine. The whole machine weighs only 72 lbs., being



Motor-Driven Valve Grinder.

ideally suited for repair shops since it is operated from an ordinary light socket.

Convenient Farm-Lighting Units.

A removable control case containing all the control and safety appliances is the distinctive feature of the lighting and power unit manufactured by the Linderman Steel & Machine Co., Dayton, O. Three types of the unit are made, each of 1000-watt capacity. In the 32-volt semi-automatic model the engine is started by pressing a button and is automatically stopped when the batteries are charged. In the full-automatic design the engine starts and stops automatically. The 110-volt full-automatic unit has no storage batteries. Power is generated only as needed, the turning on of a light or power switch starting the engine automatically.

Heavy-Duty Bus Support.

Two porcelain insulators used with a single cast-iron base to carry the loads imposed by heavy buses are the features of a new unit bus support brought out by the Lewis & Roth Corp., Philadelphia. Different forms of clamps are provided for horizontal or vertical arrangements of bus-bars.

ACTIVITIES IN THE TRADE

Business Developments, Sales Agencies, Trade Literature and Miscellaneous Items Concerning Electrical Manufacturers and Allied Business Interests

Ray Ryan Electric Co., Pittsburg, Kan., has purchased a site adjoining its North Broadway building and will erect another structure.

Union Electric & Machine Co., Charleston, W. Va., has filed notice of an increase in capital from $25,000 to $50,000 for proposed expansion.

L. B. Allen Co., Inc., 4517 North Lincoln street, Chicago, has issued several folders covering its line of soldering fluxes and soldering tools.

A. F. Daum, Pittsburgh, has issued bulletin 20-1 illustrating and describing the "Daum" refillable cartridge fuses for electric light and power purposes.

Star Porcelain Co., Muirheid avenue, Trenton, N. J., manufacturer of electrical porcelain specialties, has filed plans for the erection of an addition to its plant.

General Electric Co., Schenectady, N. Y., is erecting a plant on Bond street, Bridgeport, Conn., for the manufacture of small motors. The structure will be 40 by 50 ft.

Berg-Clark Electric Co., 1207 Euclid avenue, Cleveland, is having plans prepared for the erection of a two-story structure for general works service, estimated to cost $50,000.

Ford, Bacon & Davis, engineers, 115 Broadway, New York City, have issued a pamphlet explaining the main features of the "service at cost" plan for electric railways and other public utilities.

Frederick Engineering Co., Frederick, Md., is installing four of its underfeed stokers to burn coke breeze in connection with 1500-hp. boilers at the Youngstown (O.) plant of the Carnegie Steel Co.

National Lamp Works of General Electric Co., Nela Park, Cleveland, has awarded a contract for the erection of a two-story factory, 82 by 132 ft., at 757 East Ferry street, Buffalo, to cost about $120,000.

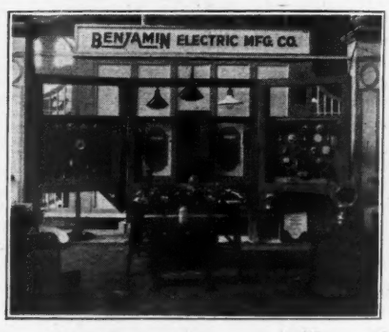
Pittsburgh Gage & Supply Co., Pittsburgh, manufacturer of electric washing machines, has awarded a contract for the erection of a one and one-half story building, 140 by 140 ft., to cost about $175,000.

Paul V. Vandevelde, electrical contractor, Corona, N. Y., has issued a booklet on his patented burglar-alarm system which can be applied to any door lock manufactured. This device was exhibited at the recent New York Electrical Show.

Metropolitan Electrical Products Co., 1250 Atlantic avenue, Brooklyn, N. Y., exhibited at the New York Electrical Show an electrical bath apparatus which affords ready control of water temperature. In addition, an electric dishwasher, made in sizes for home and restaurant use, created much interest. The company also made a display of electrical protective devices.

Ideal Electric & Manufacturing Co., Mansfield O., has issued in loose-leaf form bulletins 1015, 1033, 1034, 1044, 1046 and 1611, illustrating and describing the various types of motors and dynamos manufactured by the company.

Benjamin Electric Manufacturing Co., Chicago, had an exhibit at the Marine Show held at the Coliseum, Chicago, last month, the principal part consisting of a board of three parts hinged together, upon which were shown various devices, fittings and fixtures manufactured by the company for marine purposes. In the center was a large Benjamin-Starrett panelboard, such as is recommended for marine work, the same being illuminated by a Benjamin elliptical angle reflector. Two interesting parts of the exhibit were the Benjamin pilot-house panel and the Benjamin watertight bell immersed in water. The pilot-house panel was connected with



Marine Show Exhibit of Benjamin Electric Manufacturing Co.

a circuit permitting the buzzer and lights to operate at intervals. The bell was also connected with a circuit and operated by a push button, demonstrating that this device is actually water tight.

Allen-Bradley Co., Milwaukee, has issued bulletins F-2250 and L-1210, the former describing the clapper type controllers for mill, crane and hoist service, and the latter the unit section battery-charging panel for electric vehicles and trucks.

United States Mortgage & Trust Co., 55 Cedar street, New York City, installed a booth at the recent New York Electrical Exposition, representing a section of the bank in miniature, where its representatives were in attendance to render to exhibitors and depositors such banking assistance as was required.

Binder Elevator & Electric Co., Birmingham, Ala., has moved to another location at 420 North 20th street. The new store is nearly double the size of the one just vacated and affords ample opportunity for displaying the large stock of electrical fixtures and appliances carried by this company.

Black & Decker Manufacturing Co., Towson, Md., manufacturer of electrically operated hand drills, has awarded a contract for the construction of a one-story machine shop.

Shapiro & Aronson, 245 Glenmore avenue, Brooklyn, N. Y., manufacturer of lighting fixtures, is having plans prepared for the erection of a one-story addition to its plant, 100 by 200 ft., estimated to cost $50,000.

Oliver Electrical Works, 420-22 South 20th street, Birmingham, Ala., has been established by S. W. R. Oliver, formerly of the Oliver-Walstrum Works. Coil-making machinery and a bake oven with automatic regulators will be installed.

Goyer Co., Inc., Hartford, Conn., manufacturer of electrical specialties, has acquired property at Willimantic, Conn., formerly held by the Foster-Stewart Co., for the establishment of a new plant. It is proposed to remove the company's Hartford works to this location.

Duplex Lighting Works of General Electric Co., 6 West 48th street, New York City, is sending to dealers a folder entitled "It Opens the Door to You," which gives a reproduction of the "Duplexalite" color page to appear in the Nov. 6 issue of the "Saturday Evening Post." This advertisement is the high spot in the home-lighting campaign inaugurated by the company, which is supplying dealers with window decorations, posters, booklets, mailing cards and newspaper electrotypes, so they may reap the benefits of the national publicity.

Habirshaw Electric Cable Co., Yonkers, N. Y., has published a "1920 Manual of Wires and Cables," which contains valuable information for the trade. It is profusely illustrated and gives names, types and descriptions of different wires and cables. The processes of the manufacture of rubber-insulated wire are explained and pictured. The subject of the wiring of building and homes follows, with the wiring plan of three floors of a modern home. The last 20 pages of the 172 comprising the manual are devoted to wire tables and measures.

Cutler-Hammer Manufacturing Co., Milwaukee, in a booklet recently published bearing the title "C-H Control Apparatus for Pumps, Compressors and Similar Service," and known as publication 860, illustrates and describes in a general way the control of motor-driven pumps and compressors on water and compressed air systems in mines, on board ships, for hydraulic elevators, etc. Every C-H product used for this class of service is described, including manual and automatic starters and speed regulators and accessories, such as pressure regulators, float switches, push buttons, etc. A condensed chart is given to aid in the selection of the proper control equipment for each particular class of service.

PERSONAL MENTION

Biographical Sketches and Chronicle of Changes in Business Connections, Promotions and Other Personal News of the Industry

E. J. STEPHENSON has been appointed civil engineer of the United Light & Railways Co., Davenport, Ia.

E. W. LLOYD, general contract agent of the Commonwealth Edison Co., Chicago, has been elected president of the Evanston Golf Club.

P. T. SEALEY has been appointed general manager for the receiver of the Texas Gas & Electric Co., with headquarters at Houston, Tex.

W. A. JUDD has resigned as general superintendent of the municipal waterworks and electric light plant at Dover, O., to return to private practice.

WASHINGTON DEVEREUX, who was elected president of the National Association of Electrical Inspectors at the annual convention of that organization held in Philadelphia Oct. 12-13, is chief of the electrical department of the Philadelphia Fire Underwriters' Association. His career in the electrical industry began in June, 1880, with the Bell Telephone Co. of Pennsylvania. Mr. Devereux is one of the best known electrical inspectors in the country and has been active in movements for the improvement of electrical construction and business conditions in the electrical industry. He is the originator of the Electrical Conference which meets once a month and comprises inspectors and district managers of the Philadelphia Electric Co., municipal inspectors, electrical contractors and mechanics, and inspectors of the Philadelphia Fire Underwriters' Association. This conference discusses Code regulations and methods of co-operation between the various branches of the electrical industry. He has already served one term as president of the National Association of Electrical Inspectors, being elected to that office in 1917.

Washington Devereux.

SAMUEL A. CHASE, Westinghouse Electric & Manufacturing Co., will be one of the speakers at the convention of the Southeastern Geographic Division of the National Electric Light Association to be held in Miami, Fla., Nov. 16-19.

WILLIAM L. GOODWIN, General Electric Co., will address the members of the Southeastern Geographic Division of the National Electric Light Association at Miami, Fla., during the convention on Nov. 16-19. He will also speak before the Electric Club of Chicago on Nov. 30; the contractors of South Bend, Ind., Dec. 1, and the Central Electric Railway Association, which will hold its annual convention at Indianapolis on Dec. 2-3.

J. W. DIETZ, who is educational director of the general commercial departments of the Western Electric Co., has been appointed by the New York University to head a group of executives who will discuss the principles and methods of training employes at its school of commerce this year. The course will take up specific problems of training the office boy, the clerical worker, the skilled shopman, the supervisory force, the salesman and the technical expert. Mr. Dietz is one of the pioneers in the employe training field and has been active in educational, industrial and personnel work since 1911, when he was made educational manager of the Western Electric Co.'s plant near Chicago, where more than 21,000 people are employed. He has been co-ordinating the national education and employment problems of the company since January, 1919.

L. W. CHUBB, engineer of the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., has been appointed manager of the newly-created radio engineering department of the company. He has been engaged in both theoretical and practical work with the Westinghouse company for 15 years, having joined the company as a student engineer after graduating from the electrical engineering course of the Ohio State University in 1905. During the past year Mr. Chubb has been on special duties in the material and process engineering department, and before that for over ten years he was in charge of the electrical section of the research division, engineering department. For many years Mr. Chubb has been an active member of committees of the American Institute of Electrical Engineers, and at the present time he is a member of the meetings and papers committee, standard committee and electric physics committee of that organization. He is also a member of the United States national committee of the International Electrotechnical Commission. During the time Mr. Chubb has been associated with the Westinghouse company he has received patents on nearly 100 inventions in almost every phase of electrical engineering.

ERNEST S. JEFFERIES, who was elected president of the Association of Iron and Steel Electrical Engineers at the recent convention of that organization, occupies the position of electrical engineer for the Steel Co. of Canada, Ltd., Hamilton, Ont. He has served three years as a member of the iron and steel industry committee of the American Institute of Electrical Engineers, and for a similar period has been a member of the board of directors of the Association of Iron and Steel Electrical Engineers. Mr. Jefferies is a native of Ohio, having been born in that state in 1887. For a year and a half he was in the employ of the Marconi Wireless Telegraph Co. In 1912, he finished a four-year course in mechanical engineering at the Worcester Polytechnic Institute, since which time he has held his present position with the Steel Co. of Canada.

E. S. Jefferies.

P. S. POGUE, president of the Louisville (Ky.) Home Telephone Co., has been elected president of the Central Home Telephone & Telegraph Co. and vice-president of the Independent Long Distance Telephone & Telegraph Co. The three companies have been united under one operating head and Mr. Pogue will be the active officer in charge of the operation of the long distance company. He takes the position formerly held by Edward H. Cady, Toledo, O., who remains as vice-president of the Central Home company.

OBITUARY.

WARD S. HOWE, foreman of the Pittsburgh-Beaver Light Co., died last month while at work on the new Ambridge station. He had been in the employ of the Duquesne Light Co., Pittsburgh, and its affiliated companies for over 17 years.

BUSINESS OPPORTUNITIES

News of Electrical Construction Projects in All Parts of the Country, Proposals Invited, Foreign Trade Openings and New Companies

EASTERN STATES.

Bangor, Me.—Electric motors and other electrical equipment will be installed in the new plant, 83 by 322 ft., of the Kennebec Paper Co. in Augusta, Me.

Rutland, Vt.—The Vermont Hydroelectric Co. is now operating at its new generating plant, known as Glenn station. The plant will develop power at 13,200 volts, and a large portion of the output will be stepped-up to 44,000 volts for transmission-line service.

Rutland, Vt.—The Vermont Milling Products Co. has construction under way on a plant unit, and contract for electrical service has been awarded to the Vermont Hydroelectric Co. The mill is expected to be ready for service by Dec. 1, with connected load of about 900 hp. A new plant building will be commenced at this time, to be completed for service by next spring, bringing up the power requirements to 1200 hp.

Danvers, Mass.—The power department, Commonwealth of Massachusetts, 3 State House, Boston, has awarded a contract to the E. H. Porter Co., 13 Wallis street, Peabody, for the erection of a one-story power plant at the State Hospital, Danvers, estimated to cost $250,000.

Fall River, Mass.—The Fall River Electric Co. has made application to the State Department of Public Utilities for permission to increase its stock issues to $700,000, the proceeds to be used in part for extensions and improvements in electric power plants and system.

Norwood, Mass. — Construction work is under way on a power plant for the Holliston Mills at their textile works on Lenox street. In addition to the electrical equipment to be installed at this station, electric motors and other apparatus will be used in other buildings now being erected.

Wakefield, Mass. — The Heywood Brothers & Wakefield Co., manufacturer of furniture, has construction under way on a one-story power house, 40 by 50 ft., for general works service.

Ansonia, Conn.—Considerable electrical and mechanical equipment will be installed in the factory addition under construction for the American Brass Co., estimated to cost $750,000.

Waterbury, Conn.—The Waterbury Rolling Mills, Inc., has awarded a contract to Tracy Brothers Co., 52 Benedict street, for the erection of a one-story transformer house at its works.

Albany, N. Y.—The superintendent of state prisons, Charles F. Rattigan, Capitol building, has plans under way for the erection of an addition to the power house at Sing Sing Prison, Ossining, N. Y. Bids for the work will be asked at an early date.

Buffalo, N. Y.—A number of members of the city commission have signified their approval of the establishment of a municipal gas works, to be operated in conjunction with the proposed municipal hydroelectric plant. It is planned to arrange a bond issue of $10,000,000 to cover the cost of the project.

Buffalo, N. Y.—Corporation Counsel Wm. S. Rann and Engineer F. W. Ballard have applied for permission for water power. The city council desires to construct a power-generating and distributing plant.

New York, N. Y.—The United Electric Light & Power Co. has completed plans and will soon award contracts for the erection of its proposed power plant on property recently acquired at 134th street and the East river, estimated to cost in excess of $3,000,000. T. E. Murray, Inc., 55 Duane street, is engineer.

Crosswicks, N. J. — Charles W. Brick has been granted permission by the Board of Public Utility Commissioners to construct a local electric power plant for commercial service in this district. A distributing system will also be established. It is planned to inaugurate construction at an early date.

East Orange, N. J.—Electric motors as well as other electrical and mechanical equipment will be installed in the new addition to be erected at the plant of the Ward Baking Co., Fourth avenue, estimated to cost in excess of $75,000.

Maurer, N. J.—The Barber Asphalt Paving Co., 233 Broadway, New York City, will construct a power plant in connection with the new buildings to be erected to take the place of those at Maurer recently destroyed by fire.

Trenton, N. J.—Plans have been prepared for extensions and improvements in the power house at the New Jersey Home for Girls on Stuyvesant street, estimated to cost $15,000. Francis H. Bent, 142 West State street, state architect, is in charge.

Wilmington, Del. — The Phillips Light & Power Sales Co., Minneapolis, Minn., has been incorporated with a capital of $100,000, to construct a light and power system here. Incorporators: Howard A. Robinson, Frank S. Robinson and Clifford Schultz, Minneapolis.

Drumore, Pa.—The East Drumore Electric Co. has been organized to operate a local power plant. Harry L. Long is treasurer.

Foxburg, Pa.—The Rockland Water Power Co. has been incorporated with a capital of $5000, to operate a local power plant. Charles W. Young, Boston, Mass., is treasurer.

Glen Rock, Pa.—The Glen Rock Electric Light & Power Co. has made application to the Public Service Commission to issue capital stock to the amount of $80,000, to be used for plant extension and equipment.

Newton Square, Pa.—In connection with the erection of a number of new school buildings, the board of directors of the College for Fatherless Girls, West Chester Pike, will build a power house for service at the institution.

Philadelphia, Pa.—The Glen Knitting Mills, Second and Westmoreland streets, has filed plans for the erection of a one-story power plant, 50 by 100 ft., at Twentieth and Clearfield streets, estimated to cost $52,000.

Ransom, Pa.—A one-story power house, estimated to cost $57,794, will be erected by the Ransom Poor District, John J. Gorman, director, at its local institution. Herman Mailander, 167 Blackman street, Wilkes-Barre, has the construction contract.

Reading, Pa. — The Metropolitan Edison Co. has made application to the Public Service Commission to issue bonds to the amount of $65,000, for plant betterment and general financing.

Waynesboro, Pa.—Borough Engineer Payne is preparing plans for a water power plant for Antietam.

Baltimore, Md. — Electric motors, mechanical and refrigerating equipment will be installed in the one-story plant for the American Ice Co., 24 Hampton street. The plant is estimated to cost $100,000, including equipment.

Baltimore, Md.—Construction work is under way on the power plant for the Maryland Casualty Co. on Merryman Lane and Fortieth street, in connection with its new printing plant and administration building at this location. The entire project will cost about $2,000,000.

Baltimore, Md.—Electric motors, mechanical and refrigerating equipment will be installed in the new plant for the Horn Ice Cream Co., 44 Aisquith street. The plant is estimated to cost about $300,000, including machinery.

Cecilton, Md.—The Cecilton Electric Light & Power Co. has filed notice of an increase in capital to $10,000.

Clifton Forge, Va. — The Chesapeake & Ohio Railway Co. has awarded a contract to the Arnold Co., 105 La Salle street, Chicago, for the erection of a power plant to be used in connection with other structures for works service. The entire cost of the project is estimated at $600,000.

Charleston, W. Va. — Bureau of Yards and Docks, Washington, D. C., Navy Department, is asking for bids up to Nov. 17, for the installation of an electrical distributing system at Charleston Navy Yard (Specification 4294).

Huntington, W. Va.—The Mountain State Coal Co. has had plans prepared for the construction of a one-story electric power plant at its prop-

erty at Coal Lands, Ritter, W. Va. C. T. Benton is president.

Princeton, W. Va.—The Princeton Power Co. has filed notice of an increase in capital from $250,000 to $300,000, for proposed expansion.

Red Springs, N. C.—The common council has awarded a contract to the Virginia Machinery & Well Co. for the installation of a new electric light system.

NORTH CENTRAL STATES.

Akron, O.—Bids will be received Nov. 8 for improvements to the boulevard lighting system on Storer avenue from Amelia to Delia avenues. Address E. A. Zeisloft.

Cleveland, O.—For the purpose of erecting an electric light plant in East Cleveland a bond issue of $90,000 is to be voted. Address A. Carran, City Hall, East Cleveland.

London, O.—The municipal electric light plant has been purchased by Kehoe & Brideman, who will run a 13,200-volt transmission line from Springfield, O., furnishing light and power to London as well as the farmers along the right-of-way. Motors, transformers and line material will be needed. Address M. J. Kehoe, electrical engineer, Springfield, O.

Newark, O.—The Commonwealth Power Co. has been incorporated with a capital of $150,000. Address W. C. Miller.

Benton Harbor, Mich.—A committee has been appointed to provide ways and means of installing curb lights. It is proposed to have the iron lamp parts made at local foundries. Address Alderman Edward Warrier.

Coldwater, Mich.—To improve the light and water plant here $50,000 is required. Address L. E. McQueey, superintendent of the board of public works.

Eaton Rapids, Mich.—The load on the electric lighting and power equipment in the city has increased so rapidly that another 50-kw. generator is badly needed. Address city clerk.

Holland, Mich.—The city council has adopted a plan for a uniform system of boulevard lights for the city.

Lake City, Mich.—The Winterfield Light & Power Co. is erecting a plant on the Clam river. A committee of citizens is making arrangements to obtain the necessary energy from the company to provide the village with light and power. Address Henry Miltner.

St. Johns, Mich.—The municipal electric light plant was damaged by fire recently. The machinery is not a total loss, as the dynamos can be rewound. Address Manager Townsend.

Milan, Ind.—The Milan Light & Power Co. is erecting a transmission line from this place to Moores Hill, Ind., where a franchise was recently acquired. Address W. E. Lewis, superintendent.

Dixon, Ill.—The Sandusky Cement Co. plans to erect a one-story power house addition at an estimated cost of $100,000, contract for which has been let to the Pan-American Steel Co., Evansville, Ind.

Springfield, Ill.—Flashlight warnings at every railroad crossing and markers at all crossroads on the Illinois system of improved highways, which when completed will touch every county seat in the state, are to be installed by the State Division of Highways. Address S. E. Bradt, state superintendent.

Taylorsville, Ill.—W. S. Merkle, engineer, 129 Market street, St. Louis, has prepared plans for the erection of a municipal electric lighting plant for the city. Address T. J. Downey, mayor, Taylorsville.

Urbana, Ill.—Members of the University District Improvement Society are much interested in the proposed lighting system to be installed in the university district. Address H. B. Ramey, commissioner.

Junction City, Wis.—The Junction City Lighting Co. has been organized with a capital of $5000 to erect an electric light plant. Address Paul Bernhagen.

Milwaukee, Wis.—An application for issuing $5,000,000 of 7.5% 25-year sinking fund gold bonds by the Wisconsin Electric Power Co., guaranteed by the Milwaukee Electric Railway & Light Co., has been entered with the Wisconsin Railroad Commission. The bonds will be used for the construction of a power and lighting plant in Cudahy, Wis.

Norwalk, Wis.—The Wisconsin River Power Co. may extend its lines in the near future to the village of Norwalk, Monroe county, and consumers in that locality have signified their willingness to pay the $14,000 to make the necessary extension.

Oshkosh, Wis.—William A. Bachr, engineer, has prepared plans for an ornamental street-lighting system. Address Ira Parker, city chairman.

Union Grove, Wis.—Plans are being prepared by John C. White, engineer, Madison, for a power plant at the Southern Wisconsin Home for the Feeble Minded. Address M. J. Tappins, secretary of the State Board of Control, Madison, Wis.

Beaver Creek, Minn.—An electric lighting system is planned for the city. Address B. R. Page, city clerk.

Eveleth, Minn.—The farmers living in the vicinity of Wolf have requested that the Minnesota Utilities Co. of this city furnish them with electricity on their farms. The company has made an agreement with the petitioners to furnish the energy if a sufficient number are found who are desirous of having the service installed. Address William Haenke.

Marshalltown, Iowa.—The construction of a lighting system is contemplated by the city. Address John I. Bell.

Melrose, Ia.—The power plant of N. J. Coleman was destroyed by fire recently.

Koch, Mo.—The city council has construction work under way on an addition to its municipal power plant. It will be one-story, 65 by 79 ft., and is estimated to cost $22,000.

Ottawa, Kan.—Bonds amounting to $165,000 have been voted for improvements to the municipal water and light plant. Address city clerk.

Pleasanton, Kan.—The city has had plans prepared by E. T. Archer & Co., engineer, New England building, Kansas City, Mo., for the erection of an electric light plant.

Peru, Neb.—A special election will be held to vote on the issuing of $10,000 in bonds for the purchase and improvement of the Peru Electric Light & Power Co.'s plant.

SOUTH CENTRAL STATES.

Lee, Ky.—The Cumberland-Hazard Coal Co. is considering the erection of an electric power plant to cost about $75,000.

Rogersville, Ala.—The Rogersville Light & Power Co. is considering plans for the erection of a local plant to replace its power station recently destroyed by fire.

Louisville, Miss.—Municipal light bonds to the amount of $36,000 have been voted. Address the mayor.

Winona, Miss.—The council has ordered an election to be held to vote on the question of issuing $60,000 in bonds to purchase the water, light and ice plant. Address the mayor.

Cyril, Okla.—The municipal light plant was destroyed by fire recently.

Breckenridge, Tex.—The Oil Belt Power Co., Eastland, Tex., will install a transformer station and construct distribution lines through various towns and into the oil fields.

Kennedy, Tex.—The Kennedy Oil Mill is having plans prepared for the erection of an electric-light and power plant.

WESTERN STATES.

Shelley, Ida.—The Shelley Light & Power Co. will improve its plant. Address H. L. Malcomb, president.

Brigham City, Utah.—The Hanchett Bond Co., 39 South LaSalle street, Chicago, has purchased $200,000 worth of electric light bonds. The municipal light plant will be rebuilt.

Spokane, Wash.—The Washington Water Power Co. plans to develop the upper falls of the Spokane river. Address D. L. Huntington, president.

Bandon, Ore.—E. C. Miller, electrical engineer, Seattle, Wash., has made plans and estimates for a municipal hydroelectric plant, to consist of a 300-kw. unit, to operate under 700-ft. head, on Willow creek, where a timber-crib dam will be built to form a storage reservoir. The cost of the project is estimated at $105,000. At the Nov. 2 election a proposal to issue bonds to finance the enterprise was to be voted on.

Burns, Ore.—Louis C. Kelsey, engineer, has prepared plans for the construction of a municipal lighting plant to cost about $53,000.

Freewater, Ore.—The Peacock Mill Co. has petitioned for water rights for the purpose of erecting a power plant in Umatilla county. The plant is to be constructed in units and completed within four years. The construction work includes a pipe line 1.5 miles long, a concrete weir for diversion and 54-in. wood pipe for conveying water to turbine for the first unit, which is estimated to cost $140,000.

The Dalles, Ore.—An ornamental street lighting system is to be installed here, contract for which has been awarded to R. A. Twiss.

Wilsonville, Ore.—Plans have been prepared by N. W. Young for the extension of his electric light system

from this city to the Frog Pond district.

Grass Valley, Cal.—Plans are under way by the Delhi Mining Co. for the construction of a hydroelectric plant on Bloody Run. Address Harry Skewes, superintendent.

Kerman, Cal.—A lighting system will be installed here. The plans call for the installation of more than 40 street lamps. Address city clerk.

Pasadena, Cal.—William H. Reeves, commissioner of the department of public works; C. W. Koiner, general manager of the municipal lighting plant and Samuel B. Morris, chief engineer of the municipal water department, recently made a trip through the mountains inspecting possible power house sites in the event of Pasadena installing hydroelectric power plants.

San Diego, Cal.—Four new power development and irrigation projects for Southern California to cost $945,000 are outlined in applications for water-diversion permits. The San Diego Consolidated Gas & Electric Co. will spend $110,000 on diversions from Pauma and Lion creeks and will develop 1455 hp. The Southern Sierras Power Co. will spend $500,000 in developing 5793 hp. in San Bernardino county.

San Francisco, Cal.—A. P. Seybold, 1213 Hobart building, has made application to the State Water Commission for permission to appropriate water to the extent of 5200 cu. ft. per second from the Klamath river and Bluff creek, Humboldt county, for hydroelectric power development. Mr. Seybold with associates plans the erection of a power plant in this section, to cost about $2,000,000 with equipment.

CANADA.

Bass River, Nova Scotia—The Dominion Chair Co., Ltd., plans to construct an electric light plant for the village at an estimated cost of $10,000.

Riverport, Novia Scotia—The Hydroelectric Power Commission of Nova Scotia is constructing an electric light system here at a cost of $20,000.

INCORPORATIONS.

Los Angeles, Cal.—C. R. Kierulff & Co. To manufacture electrical specialties. Incorporators: C. R. Kierulff, 32 North Wilton place, Los Angeles, and others.

Los Angeles, Cal.—The Gonyer-Seydel Ingnition Co. To manufacture ignition equipment for automobile service. Incorporators: E. L. Gonyer, 820 West 40th place, and others.

New Haven, Conn.—Eller Electric Co. Capital, $10,000. To manufacture electrical equipment. Incorporators: Philip Eller and Morris Stein.

New York, N. Y.—Mutual Art Lighting Fixture Co. Capital, $25,000. To manufacture electrical fixtures. Incorporators: G. and J. Murad, 45 Grand street.

Wilmington, Del.—United Electric Corp. Capital, $1,000,000. To manufacture electrically operated cleaning machines and other appliances. Incorporators: T. L. Croteau, M. A. Bruce and S. E. Dill.

Minneapolis, Minn.—Adco Battery Manufacturing Co. Incorporated in Delaware with a capital of $1,050,000. To manufacture electric storage batteries and other equipment. Incorporators: Angus Ferguson, Henry A. Aker and Auten Pine, Minneapolis.

Middleburg, Pa.—The Perry-Snyder Electrical Co. Capital $5000. To manufacture electrical apparatus. A. J. Musser, Indiana, Pa., treasurer.

Philadelphia, Pa.—The Thompson-Levering Co. Capital $5000. To manufacture electrical equipment. Incorporators: William J. Thompson, 5907 Cobbs Creek parkway, treasurer; A. J. Levering and D. J. Corcoran.

Wilmington, Del.—The Sterling Electric Appliance Co. Capital $25,000. To manufacture electrical equipment. Incorporators: Edmond S. Heilings, William F. O'Keefe and F. E. Sterling, Wilmington.

Wilmington, Del.—Wagner Electric Corp. Capital $250,000. To manufacture electrical equipment and supplies. Local incorporators: M. A. Bruce, T. L. Croteau and S. E. Dill.

Wilmington, Del.—The Breeding Heat & Power Corp. Capital $8,250,000. To manufacture motors and electric-heating appliances. Local incorporators: C. T. Cohee, C. B. Outten and S. L. Mackey.

Baltimore, Md. — Tucker-Parthree Electric Co., Inc. Capital $50,000. To manufacture electrical fixtures and equipment. Incorporators: Francis Tucker, Clarence E. Parthree and Isaac T. Parks, Jr., 122 Hollingsworth street.

Chattanooga, Tenn.—The Royal Electric Co. Capital $30,000. To deal in electrical appliances. Incorporators: F. E. Bryant, 12 East Sixth street, and others.

Bridgeton, N. J.—The Lyons Electric Appliance Co. Capital $100,000. To manufacture electrical appliances. Incorporators: John P. Lyons, Frank R. Baker and R. E. Shoemaker.

New York, N. Y.—The Nomora Sales Corp. Capital $250,000. To manufacture electrical devices and apparatus. Incorporators: N. E. Benjamin, A. F. Stillman and H. J. Edwards, 30 Church street, New York City.

Lafayette, Ind.—The Corwin Electric Co. Capital $10,000. To manufacture telephone and electrical devices. Incorporators: Elmer E. Corwin, William Stone and S. M. Johnson.

Bridgeport, Conn.—Plaza Electric Co. Capital, $50,000. To manufacture electrical equipment. Incorporators: Samuel Bernstein, A. A. Nelson and E. M. McCue, 56 Sherman street.

Rochester, N. Y.—Henry J. Schneider Co. Capital, $100,000. To manufacture automobile batteries. Incorporators: H. R. Templeton, H. D. Shedd and H. J. Schneider.

Richmond Hill, N. Y.—Safety Fuse Handle Co. Capital, $16,000. To manufacture electrical equipment. Incorporators: G. R. Cohen, S. Green and E. V. Gluck.

New York, N. Y.—Kam-Lock Switch Box Co. Capital, $15,000. To manufacture electrical switches, switch boxes, etc. Incorporators: A. Koppelson, G. Sutta and N. Frankel, 47 West 34th street.

Newark, N. J.—Associated Lamp Co. Capital, $125,000. To manufacture electrical equipment. Incorporators: Jacob I. Kaplan, Edward P. Hacker and Joseph E. Cohen.

Philadelphia, Pa.—Commercial Electric Construction Co. Capital, $5,000. To manufacture electrical equipment. W. J. Mackey, 601 Haverford avenue, Narberth, Pa., is treasurer.

Wilmington, Del.—Electric Control Corp. Capital, $300,000. To manufacture electrical supplies. Incorporators: M. A. Bruce, S. E. Dill and T. L. Croteau.

FOREIGN TRADE.

[Addresses of firms referred to in these trade opportunities may be obtained by writing to the Bureau of Foreign and Domestic Commerce, Washington, D. C., or its branch and local co-operative offices. Request for each opportunity should be on a separate sheet and the file number given.]

Electric Fans, etc. (33,796)—A firm of wholesale dealers in India desires to purchase engines, motors, electric fans, lamps, etc. References.

Electrical Goods (33,926)—A commercial agency in India desires to import various American products such as electrical goods, etc. References.

Electrical Supplies (33,829).—The representative in the United States of a manufacturers' agent in Colombia desires to secure an agency for the sale of electrical supplies.

Electrical Supplies (33,843).—The representative of a merchant in Haiti is in the United States and desires to secure an agency for the sale of electrical supplies. References.

Electric Motors (33,838). An import and export agent in Jugoslavia desires to establish commercial relations with firms handling electric motors and accessories. Correspondence may be in English.

Electrical Apparatus, etc. (33,820).—A commercial agent in France desires to secure the representation on a commission basis of firms for the sale of electrical apparatus, lamps, electric wires and cables. Correspondence should be in French. References.

Electrical Equipment and Supplies (33,903)—A Norwegian firm is in need of electrical equipment and supplies such as insulators, insulated and non-insulated copper wire, transformers, instruments and apparatus for generating stations, and all supplies for power transmission and house installations. Quotations to be given c. i. f. Norwegian port, or f. a. s. American port. Correspondence may be in English. Reference.

PROPOSALS.

Menard, Ill.—Bids will be received Nov. 16 for the purchase of transformers for the Southern Illinois Penitentiary at this place. Address supervising engineer, Capitol annex, Springfield, Ill., or room 410, Kimball building, Chicago.

FINANCIAL NEWS

Comment on the Financial Outlook in the Electrical Industry, New Securities, Reports of Earnings, Dividends and Utility Stocks

Bond Offering of Pennsylvania-Ohio Power & Light Co.

A new issue of $13,000,000 first and refunding mortgage 7.5% sinking fund gold bonds, dated Nov. 1, 1920, and due Nov. 1, 1940, of the Pennsylvania-Ohio Power & Light Co. is being offered at 96.5 and accrued interest, yielding about 7.85%, by Lee, Higginson & Co., Drexel & Co., the National City Co., Bonbright & Co., and others. The purpose of this issue is for the company to acquire properties which supply electric power and light to indutrial territory in Pennsylvania and Ohio, midway between Pittsburg and Cleveland, including Youngstown, O., serving a population in excess of 300,000. The company also will own certain electric railway lines directly or through subsidiary companies.

Bonds of San Joaquin Light & Power Corp. Sold.

Announcement is made that a new issue of $2,625,000, Series "D," 15-year, 8% convertible collateral trust bonds of the San Joaquin Light & Power Corp. has been disposed of at 100 and accrued interest, yielding 8%. This series of bonds was issued to meet present financial requirements of the company for funding current indebtedness created in developing 70,000 additional horsepower, 54,000 of which is hydroelectrically generated and all of which has been connected and sold at remunerative rates.

Stock Issue Planned by Pacific Gas & Electric Co.

The Pacific Gas & Electric Co., San Francisco, has asked the California State Railroad Commission for authority to issue $5,000,000 first preferred stock, which will bring the amount outstanding to about $36,000,000. It is planned to use the proceeds from this issue to finance the company's hydroelectric power and construction program.

Bond Offering of Westinghouse Oversubscribed.

A recent offering of Westinghouse Electric & Manufacturing Co. 7% gold bonds at 94.75 and interest, to yield about 7.75%, was heavily oversubscribed within a short time after the books were opened. The bonds are dated Nov. 1, 1920, and will fall due May 1, 1931.

General Electric Co. to Issue Debentures.

It is reported that the General Electric Co. plans to dispose of an issue of $20,000,000 of 6% debentures now held in the company's treasury.

Cities Service Co.

The report of the Cities Service Co. for September and the 12 months' period shows earnings as follows:

	1920.	1919.
September gross earnings	$2,074,085	$1,460,921
Net earnings	2,012,040	1,402,012
Surplus after fixed charges	1,844,886	1,241,238
12 months' gross	23,818,909	20,519,519
Net earnings	23,119,094	19,828,187
Surplus after fixed charges	21,187,850	18,212,114

The company declared the regular monthly dividends of one-half of 1% in cash on the common, preferred and preference "B" stocks, and 1.25% in stock on the common stock, all dividends payable Dec. 1 to stock of record Nov. 15.

Alabama Power Co.

	1920.	1919.
September gross	$ 361,221	$ 258,552
Net after taxes	174,814	125,690
12 months' gross	3,871,209	2,949,810
Net after taxes	2,031,874	1,561,052

Nine Months' Earnings of Western Union Telegraph Co.

The earnings report of the Western Union Telegraph Co. for the nine months ended Sept. 30, 1920 (month of September estimated), is as follows:

Gross revenues, including dividends and interest	$91,590,000
Maintenance, repairs and reserved for depreciation	12,212,000
Other operating expenses, including rent of leased lines, taxes and employes' income participation	68,181,000
Total expenses	80,393,000
Balance	11,197,000
Deduct interest on bonded debt.	999,000
Net income	10,198,000

The operating income for the first nine months in 1919 is not stated for comparison by the company, as the land line system was under federal control for a part of that period.

Carolina Power & Light Co.

	1920.	1919.
August gross	$ 124,601	$ 95,985
Net after taxes	26,929	28,666
Total income	30,409	30,546
Surplus after charges	12,575	14,634
12 months' gross	1,490,696	1,136,772
Net after taxes	419,329	385,575
Total income	588,818	543,716
Surplus after charges	387,815	353,919
Balance after preferred dividends	255,168	228,283

Western States Gas & Electric Co.

Comparative earnings of the Western States Gas & Electric Co. for the 12 months ended Sept. 30, 1920, and 1919, are as follows:

	1920.	1919.
Gross	$2,156,911	$1,812,939
Net	834,424	750,774

Philadelphia Co. and Subsidiaries.

	1920.	1919.
September gross	$ 941,974	$ 666,397
Net after taxes	434,969	95,429
Nine months' gross	10,985,848	9,107,962
Net after taxes	6,102,884	4,092,171

Nevada-California Electric Corp. and Subsidiaries.

	1920.	1919.
August gross	$ 281,620	$ 259,357
Net after taxes	158,074	151,201
Total income	157,161	150,785
Surplus after charges	75,559	68,445
12 months' gross	2,086,360	1,760,333
Net after taxes	1,080,557	980,779
Total income	1,075,241	979,538
Surplus after charges	476,672	397,614

Dividends.

The Fort Worth Power & Light Co. has declared its regular quarterly dividend of 1.75% on the preferred stock, payable Nov. 1 to stockholders of record Oct 21.

The Pacific Power & Light Co. has declared its regular quarterly dividend of 1.75% on the preferred stock, payable Nov. 1 to stockholders of record Oct. 22.

The Sierra Pacific Electric Co. has declared its regular quarterly dividend of $1.50 on the preferred stock, payable Nov. 1 to stockholders of record Oct. 20.

The Tampa Electric Co. has declared its regular quarterly stock dividend of $2.50, payable Nov. 15 to stockholders of record Nov. 1.

The Cities Service Co. has declared its regular monthly dividend of 41.5 cents on the bankers shares, payable Nov. 1 to stockholders of record Oct. 15.

The American Waterworks & Electric Co. has declared its regular quarterly dividend of 1.75% on the preferred stock, payable Nov. 15 to stockholders of record Nov. 1.

The Columbia Gas & Electric Co. has declared its regular quarterly stock dividend of 1.25%, payable Nov. 15 to stockholders of record Oct. 30.

The Cape Breton Electric Co. has declared a semi-annual dividend of $3 on its preferred stock, payable Nov. 1 to stockholders of record Oct. 18.

The Edison Electric Illuminating Co. of Brockton, Mass., has declared its regular quarterly stock dividend of $2, payable Nov. 1 to stockholders of record Oct. 18.

WEEKLY COMPARISONS OF CLOSING BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeiler & Co., Rookery Bldg., Chicago.

	Div. rate. Per cent.	Bid Oct. 26.	Bid Nov. 3.
Public Utilities—			
Adirondack Electric Power of Glens Falls, common	6	14	14
Adirondack Electric Power of Glens Falls, preferred	6	71	72
American Gas & Electric of New York, common	10+extra	110	106
American Gas & Electric of New York, preferred	6	37	37
American Light & Traction of New York, common	...	109	110
American Light & Traction of New York, preferred	6	81	81
American Power & Light of New York, common	4	55	54
American Power & Light of New York, preferred	6	65	64
American Public Utilities of Grand Rapids, common	..	7	9
American Public Utilities of Grand Rapids, preferred	7	22	21
American Telephone & Telegraph of New York	..	99½	100
American Water Works & Elec. of New York, common	..	3	3
American Water Works & Elec. of New York, particip	7	8	7
American Water Works & Elec. of New York, 1st preferred	..	45	47
Appalachian Power, common	..	4	4
Appalachian Power, preferred	7	20	18
Cities Service of New York, common	+extra	300	308
Cities Service of New York, preferred	6	65	65
Commonwealth Edison of Chicago	8	103	103
Comm. Power, Railway & Light of Jackson, common	..	20	18
Comm. Power, Railway & Light of Jackson, preferred	6	45	42
Federal Light & Traction of New York, common	..	8	8
Federal Light & Traction of New York, preferred	..	45	46
Northern States Power of Chicago, common	..	42	44
Northern States Power of Chicago, preferred	ex.div.7	79	78½
Pacific Gas & Electric of San Francisco, common	..	54½	55
Public Service of Northern Illinois, Chicago, common	7	65	65
Public Service of Northern Illinois, Chicago, preferred	6	85	85
Standard Gas & Electric of Chicago, common	..	16	16
Standard Gas & Electric of Chicago, preferred	8	37	37
Tennessee Railway, Light & Power of Chattanooga, common	..	2	1½
Tennessee Railway, Light & Power of Chattanooga, preferred	6	5	4
Western Power of San Francisco, common	..	20	22
Western Union Telegraph of New York	extra	92	92
Industrials—			
Electric Storage Battery of Philadelphia, common	4	120	120
General Electric of Schenectady	8	138	139
Westinghouse Electric & Mfg. of Pittsburgh, common	7	47½	48